

# Noise Ordinances

## Tools for Enactment, Modification and Enforcement of a Community Noise Ordinance

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**Forty ordinance provisions that cover most modern community sound sources are listed. There are examples of newer definitions and excerpts from state and local noise ordinances relevant to those provisions. A chapter is dedicated to enforcement methods for each of the provisions.**

## Foreword

If a person throws any of his garbage into a neighbor's yard, most communities are quick to respond. If a person throws a lot of his acoustical garbage (noise) into a neighbor's yard, most communities are very slow to respond. It is the aim of this document to change that, since the preamble of the US Constitution states "...to ensure the domestic Tranquility...".

This document is not a model code. Those documents provide specific code provisions with little explanation. It is not a textbook on acoustics, nor one on law. It contains an extensive list of ordinance provisions as a shopping list. Many of them have alternatives that permit the community to accommodate their particular needs. Each provision has a comment section that discusses its intent, its strength and weaknesses,. One chapter covers enforcement methods for each of the listed provisions.

The noise related statutes of all fifty states and the ordinances of a large number of cities have been reviewed in order to present the wide variety of ways noise impact is handled. Each provision has a section on existing ordinance provisions, both good and bad.

One aim has been to reduce the use of vague and difficult to define terms such as "unnecessary noise", "disturbing noise", "excessive noise", and "adequately muffled". They are difficult to defend and leave room for arbitrary enforcement. An attempt has been made to develop three levels of enforcement. The first and preferred method is an objective numerical standard that can be determined with a sound level meter and is based on health and welfare studies. The second is a somewhat more subjective audibility standard related to meaningful sounds that do not require a sound level meter for enforcement. The third is the more common subjective nuisance provision that can be used as a backstop to the other methods.

The original document was written with Robert Simmons of the Environmental Protection Agency in the 1970's and the arrangement of this document is modeled on it. A version of the original document can be found on the web by typing "The Environmental Protection Agency's Model Community Noise Control Ordinance". This document is an updating of it.

The internet has a number of websites that concern noise and references to them also are included in this document.

There are a number of pro-noise groups that become very active when they are threatened with noise control. Among them are motorcyclists, loud music fans, airboat operators, concert managers, and local bars. Generally speaking those at shooting ranges do not fit into that mindset; the sound is an unavoidable consequent of the gun unless silencers are permitted. Depending on the group, they can cite the Bill of Rights (National Rifle Association), the technical difficulty of noise control (American Motorcycle Association, Bikers USA), the amount of money they bring into the community that would be lost if they were regulated (local bars), and the fact that their customers love high sound levels (rock concerts, racing events). Community officials can be intimidated by large national organizations and try to balance the potential loss of community income (which can be estimated) with the adverse health effect of noise (which is difficult to estimate).

The word "sound" is used almost exclusively in this document in preference to "noise". Sound becomes noise only when the noise ordinance is violated.

If the will or ability to enforce a noise ordinance is absent, it is nothing more than a placebo to placate noise sensitive citizens. The most successful ordinance is one that contains only those provisions important to the community. Having an overly complex ordinance reduces

the will of those responsible for enforcing it.. Amendments can always be made to address new problems as they arise. Updated July 2014

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# Chapter 1

## Introduction

### The Reasons for Noise Ordinances

Machinery use has increased exponentially over the last two hundred years. One byproduct of machinery use is sound. Electronic devices have also changed the audio soundscape in the recent past. Noise is defined as *unwanted* sound. This definition converts the physical process of sound to a subjective evaluation which can be the bane of noise ordinance enforcers. How can a supposedly subjective problem be made sufficiently objective to be instituted in a noise ordinance? Resolving that question is one objective of this document.

The federal government passed the Noise Control Act to put emphasis on reduction of noise impact in the United States. The initial law is known as Public Law 92-574, passed on Oct. 27, 1972. It was amended by PL 94-301 in May 31, 1976; then PL 95-609 on Nov. 8, 1978 and again by PL 100-418, Aug. 23, 1988. The passage of this act generated a lot of activity within the Environmental Protection Agency (EPA). State and local communities responded, possibly with the intent of receiving grants for noise control programs. The National Association of Noise Control Officers was formed as well as environmental bureaucracies within state and local jurisdictions. The federal government then decided that noise was a local phenomenon, relegated to state and local jurisdictions. The Office of Noise Abatement and Control within EPA was closed and over time the interest in extensive noise control programs declined. Noise pollution has not declined and the need for some degree of control is warranted. A few of the current significant noise problems are airport operations, unmuffled motorcycles, automobile boom boxes, and barking dogs.

The development of a noise ordinance has two driving forces: the citizenry and environmentally aware officials. The development is impeded by a number of other forces: bureaucratic inertia, funding problems, biased officials, pro-noise groups, manufacturers, associations, and possibly insurance companies. Opponents can include automotive manufacturers, the National Rifle Association, and manufacturers of equipment that is difficult to quiet. Chapter 2 is devoted to the process of writing an ordinance or upgrading an existing one.

There is copious information on the negative effect of noise on people so there is ample justification for declaring noise as an adverse influence on a person's mental and physical health. There is a strong basis for enacting reasonable noise ordinances. Noise impacts are cumulative, as is air pollution; they do not create physical destruction, and are generally nonlethal, so communities do not always put emphasis on this issue. Chapter 3 is devoted to generally describing the health effects of sound on people.

Many older noise ordinances have used terms such as "excessive", "unnecessary", and "raucous". These terms are highly subjective and, without adequate support, have been found to violate the First and Fourteenth Amendments to the US Constitution. Chapter 4 is devoted to the some legal aspects of noise ordinances with the intent of describing those factors which can render an ordinance provision invalid. To reduce subjectivity, terms such as "noise disturbance"

and “plainly audible” have been added. Objective standards such as maximum sound levels have been added to further strengthen the legality and enforceability of an ordinance.

At the present time, there are a number of “model” ordinances available. They recommend, or demand (New Jersey), a comprehensive set of provisions without adequate explanation or justification. Most communities are more interested in solving problems specific to them and are not interested in adding unnecessary provisions. Chapter 5 provides a list of definitions as well as description of the duties of noise control officials and the responsibility of other community departments to set a good example by complying with the ordinance. Chapter 6 provides *forty* provisions abstracted from numerous noise ordinances. Because there are many ways a particular noise problem can be addressed, many of the provisions have alternatives. In addition, comments, examples of what other communities have done, and recommended values are added for each of the provisions. As a result, the reader should have a good appreciation of the value of a particular provision and its applicability to their community.

The enforcement of an existing noise ordinance may be impeded by assignment to agencies, such as the police, who may consider that the more important criminal activities should occupy all of their time. Overcoming that resistance is a critical element in noise ordinance success. Chapter 7 is devoted to general enforcement methods as well as specific methods that may be applied to each of the provisions listed in Chapter 6. The specific means of enforcement will vary with each community and most guidance in this document is based on experience and technical matters, and does not address local social or political aspects. Successful enforcement is dependent on the specific wording of each provision so enforcement methods related to alternative provisions are noted.

In developing or modifying an ordinance, it is helpful to use those of other states and communities as a reference. In addition to references made in the comments sections of Chapter 6, Appendices A and B have been added. They provide lists of existing state and community noise ordinance provisions for land use and motor vehicles, respectively. Some have been in existence for a number of years while others are very recent, indicating the current need for noise control. Some are not well formed while others are quite comprehensive. For example, the city of Albuquerque, NM has a recent and comprehensive noise ordinance (§9-9) that covers many of the provisions listed in this document. The code also contains well written provisions on animals (§9-2), alarm systems (§9-3), mufflers (§8-6-13), and vehicle horns (§8-6-14).

When objective provisions are incorporated, some degree of understanding of the technical aspects of sound measurement is required. Appendix C discusses the nature of sound and its measurement as a resource for understanding many of the recommendations in the document. It also contains several tables that can be useful in solving field measurement problems.

Some jurisdictions, mostly states, require measurements to be made in compliance with Society of Automotive Engineers (SAE) recommended practices. These are listed in Appendix D along with American National Standards Institute (ANSI) standards on sound level meters. Most SAE practices are not really applicable to everyday sound monitoring as the requirements are so

strict that few locations in a community meet them. The reader is recommended to review them when objections by a violator are raised.

Adding objective standards to a noise ordinance requires the use of sound level meters. Most enforcement officials are not familiar with them, so procurement of the correct one can be a problem. Appendix E describes the important features of these meters and makes recommendations. The choice of meter is very dependent on the choice of provisions in the ordinance so purchase should not be made until they are defined.

Most noise violations are considered misdemeanors, and complainants say the penalties are insufficient. Appendix F lists some penalties abstracted from a number of noise statutes and ordinances to provide some information on that subject.

## **Arrangement of Noise Ordinance Provisions**

There are two fundamental ways noise problems can be handled in a community ordinance. There is no overriding advantage to either method and in many cases *both* arrangements can be incorporated into an ordinance. The format of this manual is for the first of the two arrangements below, with each noise item noted separately. However, the provisions in Chapter 6 can easily be integrated into provisions that relate to other factors of a particular activity. When developing the noise aspect of a particular situation, it is important to define whether the noise problem can be separated from other non-noise aspects; if it can, it is a candidate for a separate article.

### **Separate Chapter or Article on Noise Control**

A number of communities and states have what might be called a Noise Control Act where all noise related items are displayed therein. This approach has both advantages and weaknesses. The advantage is that if noise is the subject, the material can be located easily. Any changes or additions can be made easily and obviously. If there is a specific agency delegated to enforce the provisions, their duties are made clear with this arrangement. The weakness is that the noise aspects of a particular activity are separated from the other aspects. An example would be noisy protests where other activities, such as signs or trespass, are equally important. If the police are the enforcing agency, it may not be a significant weakness since they are empowered to handle most violations. That may not be the case with a Noise Control Officer with limited powers. This arrangement is best if there is a community effort to reduce overall noise where all actual or potential noise sources are addressed together and the procedures of Chapter 2 can be used beneficially.

### **Noise Control Integrated into Other Provisions**

Most small communities address specific issues (e.g. motor vehicles), and include such items as brakes, lighting and mufflers. The central issue is all aspects of a specific event rather than just the noise aspects. This arrangement is convenient for those writing ordinances that have little training in noise problems and is recommended when a specific noise problem is brought to light for control. For example, places of public entertainment have numerous

regulations. If noise emanating from the establishment becomes a problem, an additional provision to that article can be added.

## Types of Noise Ordinance Provisions

There are a number of fundamental choices in the writing and enforcing of a noise ordinance. The terminology described below is used throughout the provisions in this document to help define just what each provision is intended to do and how it is to be enforced.

### Emission vs. Immission Provisions

*Emission* regulations are intended to control the sound *output* of the source without regard for any specific listener. These types of regulations are most often applied to moving sources where many persons may be impacted. *Immission* regulations are intended to control the sound *input* to a specific person, or persons, without regard for the sound output of the source. These types of regulations are most often applied to stationary sound sources. On occasion, both types necessarily may be included. For example, the operation of an off-road vehicle on private property adjacent to a residential zone may require a vehicle emission control as well as an upper limit on the sound received at the residences. They need not be included in the same provision.

### Subjective vs. Objective Provisions

Subjective regulations are based on the decisions of a noise control officer (NCO) and other officials as to the degree of noise intrusion without reference to any sound level measurements (although they may be used as support). Obvious cases are complaints about voices and music. Noise disturbance and plainly audible criteria are applied here. Objective regulations are based on sound level measurements compared with maximum permitted sound level limits provided in an ordinance. They have the advantage of removing official bias, and the numbers are generally based on scientific studies of noise impact. They require the use of appropriate sound level meters. Obvious cases are measurement of motor vehicles and measurements of sound intrusion at property lines.

### Fixed vs. Relative Sound Level Limits

There are two ways to implement objective regulations. The first is a fixed sound level limit that may not be exceeded, or may be exceeded only for short times. The second is a relative sound level limit in which the limit is made relative to the existing ambient sound level. Each has advantages and disadvantages; they are discussed more fully in appropriate sections of Chapter 6.

### Active vs. Passive Enforcement

The most common form of noise enforcement is passive, based on citizen complaints. The complaints can be about stationary or moving sources. Active enforcement is sometimes necessary however. It is most often used to monitor road traffic noise or other moving sources.

Almost all of the ordinance provisions in Chapter 6 can be enforced passively, but on some occasions, active enforcement is desirable.

## Limitations of a Community Noise Ordinance

There are several important limitations to a local noise ordinance.

### Poor Building Codes

Noise ordinance officials are often asked to resolve problems between persons in multi-use buildings. (See provision 7.20 in Chapters 6 and 7). If the building code does not require good sound isolation between neighbors, it may be impossible to reasonably solve the problem short of forcing the noise maker to permanently stop. In some jurisdictions, for example, normal conversation can be heard in adjacent apartments. This is often an embarrassment for the noise control official. The only recourse is to pressure building officials to improve the building codes. There are statutes and ordinances that actually contain provisions on sound attenuation in multiuse buildings. Some of those are related to resolution of aircraft overpass sound but can easily be adapted for other purposes.

### Continuous Highway Sound

Although a community can monitor highway sound and enforce an ordinance provision that defines the maximum sound level of a *specific* vehicle, it is beyond its ability to control the overall impact of highway sound from the *collection* of vehicles. Generally it is a state highway and is often solved with the erection of highway noise barriers. The recourse is to work cooperatively with the state to define and resolve a local noise problem.

### Federal and State Preemption

The federal government can prevent a community from enacting noise controls in a number of situations, particularly those associated with transportation in interstate commerce (aircraft, railroads, trucks) and products sold in interstate commerce (see Section 4.2.1 of Chapter 4.). The state may also preempt any local ordinance; a particular example is the sound of shooting ranges (Section 7.19 of Chapter 6). Generally there is little that can be done by a community.

### Poor Land Use Planning

Land use planning by local jurisdictions is often skewed toward development. Developers can obtain permission to create residential areas that are adjacent to potential, or actual, sources of offensive sound. Examples are airports, factories, and shooting ranges. In most cases, the objection to changes is by the sound maker: “We were here first”. On the other hand, those that can create offensive sounds may obtain approval for a location adjacent to residential areas. Sky parks, motocross tracks, factories, and gravel pits are a few examples. The objection to changes is by the potentially impacted: “Not in my backyard” (NIMBY). In each case it is an issue of economics vs. citizen health and welfare. If the ordinance specifically

addresses these issues, the noise control official may be pressured to waive enforcement. If the ordinance does not address the issue, the only recourse is to pressure planning officials to consider health and welfare issues in their decisions.

## What is Not Included

This document is not a treatise on the effects of noise on humans and only a general discussion is provided. There are a number of professional and government documents on the subject.

This document is not a treatise on noise law and only a general discussion is provided. Noise litigation has been active for at least a century and there are numerous, and sometimes conflicting, resolutions to particular noise problems.

This document is not a treatise on acoustics and only a brief description of sound and its measurement is included. The subject of sound has great depth and breadth much of which is not directly relevant to a noise ordinance.

This document does not contain guidance on the political aspects of enacting and enforcing a noise ordinance. That is usually a local affair.

This document does not contain any material on the cost to a municipality of enforcement, equipment, or official training. They vary too widely and insertion of average costs may be misleading. No comments on penalty amounts are made although some data on existing penalties are included.

This document does not contain any material on the economic impact on those who create noise. It is a complex subject and specific to each type of source.

Very detailed measurement procedures for each specific sound source are not included. The geometric complexity of many measurement sites precludes that.

Although provisions addressing shooting ranges and racing events are included, the power of opponents to any regulation is sufficient that more information to oppose it needs to be obtained than that provided in this document.

Airport noise is a complex subject. It is beyond the scope of this document and only few comments are made about airport operations. Highway barriers are not addressed as they are more properly in the jurisdiction of states.

Statutes and ordinances are subject to continual change. Since updates to this document are only made aperiodically, references to them may not be current.

# Chapter 2

## Procedures for Ordinance Development

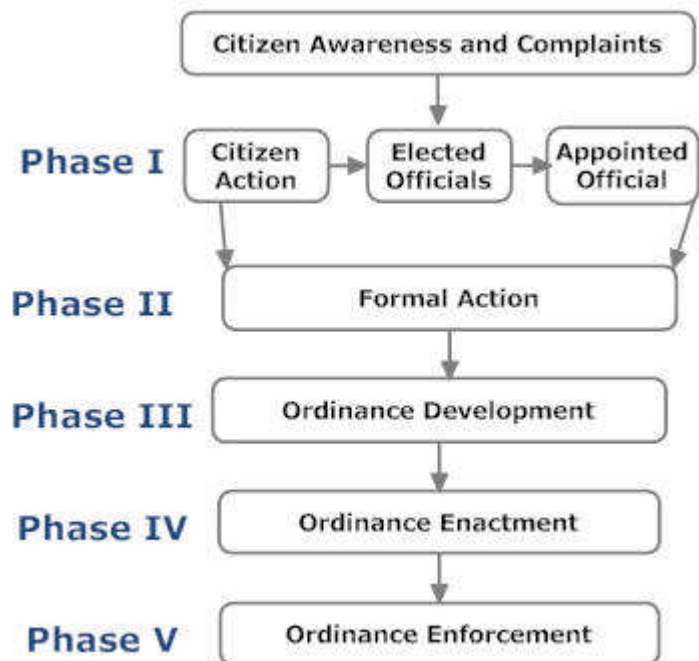
### Introduction

The process of developing, or improving, a noise ordinance is similar to the development of other ordinances. However, the details are significantly different as the subject is about something that cannot be seen, the economic impact is not easily defined, and persons are seldom in imminent danger. The key process is to decide which sound sources are unwanted (noise makers) and require regulation. This is obtained mostly from citizen feedback to officials that are not knowledgeable about noise effects. The most effective approach is to develop an ordinance to control only those noise sources that are a current concern. Modifications can be made later to add provisions to control previously unrecognized sources. The larger the list of noise sources, the more difficult is the task of development. One goal of this document is to recommend the development of objective (numerical) provisions to replace subjective, and potentially arbitrary, enforcement. This chapter is intended to help define those issues and provide the means for developing a reasonable noise ordinance.

As with other endeavors, it is worthwhile developing the noise control program correctly, whether it is a new ordinance or an amendment to an existing ordinance. This chapter has a large number of steps to bring a solution into being, not all of which need to be followed.

The basic process is shown graphically in Figure 2-1. The first phase is developing interest on the part of community officials to recognize the problem and agreement to act on it by appointing a *key official* to oversee development. The second phase is to collect sufficient information to define the problem in terms of health and welfare of the citizens and learn what the federal government, states, and other communities have done to alleviate their noise problems. Once the local problems are identified and the relevant information collected, the third phase is to create a draft ordinance for review. The fourth phase is getting the proposed ordinance accepted by overcoming external resistance (noise makers, industry), internal resistance (municipal agencies), getting approval of the legal staff, and approval of municipal officials. The last phase is, of course, assigning an enforcing agency and implementing enforcement.

The **Noise Free America** website has under “Citizen Action”, a



*Figure 2-1. Phases of Noise ordinance Development*

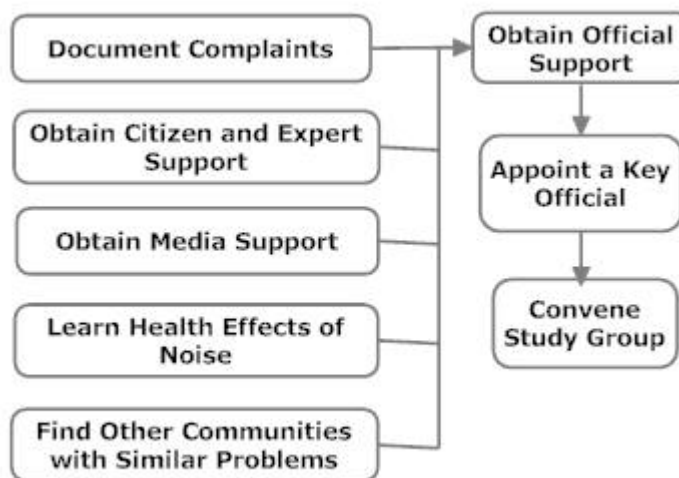


comprehensive list of recommended actions by citizens. The **Noise Off** website also has, under Strategy Guide, another list of recommended actions. They are useful supplements to this chapter.

## Phase I: Citizen Action

Most bureaucratic organizations, such as city governments, are reactive, not proactive. As a result, it is necessary to get a group of citizens to apply pressure on the government to act. The initial aim is create awareness of the problem and appreciation that something not only should be done, but also can be done without a large, expensive program. Figure 2-2 outlines

some actions that can be taken by the citizens. It starts with a nucleus of persons strongly interested in a solution to noise problems. There are a number of steps this group can take to obtain official support. They can solicit the attention of the media through direct contact or through letters to the editor. Publicity of this kind generally results in having others concerned about noise. They can solicit further support of citizens with meetings and locate those that are knowledgeable about sound and its effects. They can use local volunteers, or college students, to do an informal survey to document the severity and number of complaints about specific sound sources. Most officials are not aware of the effects of noise on man, so it is important to collect documents on that subject and become familiar with it. Good support comes from showing that other communities have successfully addressed their noise problems.



*Figure 2-2. Citizen Actions*

Some specific actions might be:

- Determine whether there really is sufficient dissatisfaction with the acoustical environment to proceed further. This can be determined through discussion with citizen groups and collection of complaint statistics from municipal agencies.
- Talk to, or collect documents from, other sources. The Environmental Protection Agency generated a large number of them in the 1970's. They may be available as PB documents. Many states and communities have current noise ordinances, many provisions of which may be relevant to the present community.
- Create a file of complaints, both those presented to authorities and others collected informally

- Identify those sound sources that of most concern in the community and rank order them. A comprehensive ordinance may not be possible, but one intended to solve the worst noise impacts may be possible.
- If there is an existing ordinance, analyze it with regard to existing noise problems.
- Borrow a sound level meter and make informal measurements of sources cited in some of the complaints. Keep records. It may be necessary to show it is technically feasible to measure sound correctly.
- Read Chapter 3 on Noise Effects and gather other documents on the subject so that a cogent argument can be made about improving the health and welfare of the citizens by noise reduction of sources that have been identified.
- Supply local media (newspapers, radio, and television) with any supportive data.
- If warranted, begin discussions with administrative officials (typically police) that may be required to enforce any noise ordinance. Understand any objections or reluctance on their part.
- Attempt to get a public session with the City Council and then present as much of the information obtained to them. If successful, the council will assign a person to create a study group to take formal action in developing ordinance concepts, hopefully with input from concerned citizens and local experts.
- Recommend persons that will provide constructive ideas for any study group.

In any meeting with officials there are several points that should be made:

- Avoid emotional rhetoric.
- There is a health and welfare problem.
- It is technically feasible to measure sound with appropriate equipment and that such equipment need not be expensive.
- There is community support for an ordinance, or a modification to an existing ordinance.
- If specific noise sources have been identified be prepared to address how they will be effected and how beneficial would be enforcement.
- Be prepared to respond to objections by commercial or industrial interests.
- Reasonable enforcement may not create undue hardship for industrial or commercial interests. If this is not true, a case should be made for the balancing of citizen health and welfare with the potential violator's hardship.
- State that specific ordinance provisions are premature at this stage and recommend that a key official and study group be assigned. The study group would relieve the key official from too much additional duty and would act to review the study group actions.

## **Phase II: Formal Action**

With official support, it is now practical to define any noise problems in detail, how resolution would improve the health and welfare of citizens, and what methods are needed to enforce a solution. The intent would be to develop a sufficient body of knowledge that a draft ordinance can be formulated. The general process is shown in Figure 2-3 below.

## Obtain Local Assistance

Potential sources of assistance are listed below:

- Citizens actively involved in Phase I activities.
- Local universities, research laboratories, audiologists, and consultants may have persons that are knowledgeable in the subject of acoustics.
- Local audiologists that are knowledgeable about hearing protection.
- Local acoustical consultants that may own equipment that can be borrowed.
- Local law firms may have persons willing to assist in the legal aspects.
- Commercial or industrial firms that may be potentially adversely impacted may have persons available.
- Local cultural groups may have persons interested.
- Government agencies may be willing to have employees participate.

Environmental Protection Agency, Regional Office  
Federal Aviation Administration, Regional Office  
Department of Housing and Urban Development, Regional Office  
Federal Highway Administration, Regional Office  
State and County Health Departments  
State and County Highway Departments  
State Environmental Officials  
Nearby communities that have enforced noise ordinances

- Community Agencies may be willing to have employees participate.
  - Police
  - Animal Control
  - Ambulance
  - Planning



*Figure 2-3. Official Actions*

## Collect Information

It is *almost* impossible to collect too much relevant information. For example, many communities have developed unique methods of controlling noise, so collecting their ordinances is vital. On the other hand, there are many scientific journals that address noise; unfortunately, most are not readily understood and pertain to noise control, not enforcement of a noise ordinance. There are a number of other sources that can be helpful.

Potential sources of information are listed below:

- Scientific journals
  - Noise and Health
  - Noise Control Engineering
  - Speech and Hearing
- Books (Several can be found on Amazon.com)
  - Kryter, K.D., “The Effects of Noise on Man”, Academic Press, 1970 (recommended)
  - Wilson, C.E., “Noise Control”, Krieger Publishing. 1994 (technical)
  - Beranek, L.L. “Noise Reduction”, McGraw-Hill, 1960 (technical)
  - Beranek, L.L., “Noise and Vibration Control”, McGraw-Hill, 1971 (technical)
  - Keizer, G., “The Unwanted Sound of Everything We Want: A Book About Noise”, Public Affairs, Perseus Books Group, 2010
  - Singal, S.P. “Noise Pollution and Control Strategy”, Alpha Science International, 2005
  - Harris, D. “Noise Control Manual for Residential Buildings”, McGraw-Hill, 1997
  - Still, H. “In Quest of Quiet”, 1970
  - Bragdon, C. R. “Noise Pollution: The Unquiet Crisis”, Univ. Penn. Press 1970
  - Hildebrand, J.L., “Noise Pollution and the Law”, 1970
- Acoustical Standards
  - American National Standards Institute (See Appendix D)
  - Society of Automotive Engineers (See Appendix D)
- Federal Regulations
  - 40 CFR 201 Noise Emission Standards for Transportation Equipment: Interstate Rail Carriers
  - 40 CFR 202 Motor Carriers Engaged in Interstate Commerce
  - 40 CFR 203 Low Noise Emission Products
  - 40 CFR 204 Noise Emission Standards for Construction Equipment
  - 40 CFR 205 Transportation Noise Emission Controls
  - 40 CFR 209 Rules of Practice Governing Proceedings under the Noise Control Act of 1972
  - 40 CFR 211 Product Noise Labeling
  - 42 USC 4910 Labeling Enforcement.
  - 42 USC 4911 Citizen Suits.
- Noise Control Act, 42 USC 4901 et seq, 1972
- US Department of Justice, Office of Community Oriented Policing Services (COPS) on Loud Car Stereos.
- Environmental Protection Agency Documents (some can be found on the National Technical Information Service (NTIS))
  - Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety EPA 550/9-74-004
  - Measurements of the Impulsiveness and Annoyance of Compression Release Engine Brake Noise, EPA 550/9-82-100, PB82-153180
  - Substrategy for Construction Site Noise Abatement, EPA 550/9-82-151, PB82-218579

A Method for Assessing the Effectiveness of Property Line Noise Control, EPA 550/9-82-406, PB82-200288

Code of Current Practices for Enforcement of Model Noise Control Ordinance, EPA 550/9-81-402, PB82-132606

Noise Violations: Guidance Manual for State and Local Prosecutors, EPA 550/9-80-425, PB82-239658

Guidelines and Sample Training Workshop for Police Enforcement of Noise Regulations, EPA 550/9-80-426, PB82-250119

State and Local Noise Enforcement Legal Memoranda, EPA 550/9-80-427, PB82-240359

Noise Emission Measurements for Regulatory Purposes, EPA 550/9-77-401, PB82-264667

San Diego, CA, Case History of a Municipal Noise Control Program, EPA 550/9-79-406, PB82-226739

Colorado Springs, CO, Case History of a County Noise Control Program, EPA 550/9-79-405, PB82-226069

- World Health Organization  
Bergland, B., Lindvall, T., Schwela, D., “Guidelines for Community Noise”, 1999. (See their Appendix for more documents)
- Web Sites  
Wikipedia  
Noiseoff.org (Noise Off)  
Noisefree.org (Noise Free America)  
Nonoise.org (Noise Pollution Clearinghouse)  
Barkingdogs.net  
Calmusa.org (motorcycle sound)
- State and Local Laws  
Chapter 6 includes discussion of the various state and city ordinances as they relate to each of the provisions in the Chapter. Appendices A and B lists the provisions of states and communities that relate to land use and motor vehicle sound. Several of the web sites above have listings of community noise ordinances. Noise Free America has the noise related statutes of all fifty states.

## Collect and Analyze Complaints

Complaints typically start in the police or sheriff’s departments, but also may be sent to the health or building departments. The Key Official should be able to have them centralized in the study group. The study group should be able to collect complaints at an official community mail box. It is recommended that a form be used for the collection of complaints. **A sample form is provided at the end of the chapter.** The purpose of the form is to provide structure to the complaint. A notice in the local newspaper would alert citizens that they can get a form from the municipality and submit it to that address, or call in and have the form filled by the listener. It is clear that volunteers would be needed for this activity.

If possible, have the form published in the local newspaper. Each of the noise sources in the form is related to the provisions in Chapter 6 so that attention can be paid to those that are considered important when the number of complaints in any category is determined.

Complaints are active responses of the citizens and provide an indication of the nature and severity of the noise problem, but does not always clearly define it. Most citizens have the attitude that little would be done if they did complain so there is a body of evidence that is not easy to obtain except through an informal survey.

## Informal Survey

The number of complaints collected is often insufficient to justify proceeding with requests for action by authorities. The nature of the problem can be defined better by simply touring the community at various times of day. If a sound level meter is available, use it to get some average levels. To avoid poor meter use, a person experienced in its use is strongly recommended. It can also be used to identify the highest levels that occur. Another benefit of the meter is that persons seeing it become curious and ask what is being done, an opportunity to explain. Keeping records of the time, location (particularly the zoning), and approximate average levels is valuable. Even this informal tour might be of interest to the local newspaper or radio station. When it is obvious that a problem exists, the next step is to do an informal survey by distributing a questionnaire. **A sample questionnaire is provided at the end of this chapter.** It attempts to learn something about the respondent, their attitudes about noise, and the noise sources in the community that they consider an important problem.

Much volunteer help is needed to do a survey. If the questionnaire below is used, training personnel may not be necessary. Use college or high school students if the teachers of environmentally oriented courses are convinced that the results of the survey would be useful to them. The Junior Chamber of Commerce and various senior organizations can be called upon for help.

The best time for a survey is when the weather is warmer and more outdoor activity is occurring; awareness is heightened. It might be winter in southern states and spring and summer in northern states.

The survey can be accomplished in three ways: (1) by interviewing residents at their home; (2) by asking questions by phone of a sample of the community; or (3) by publishing the form in the newspaper. The first choice is the most effective. The second choice is more limited in time, so fewer questions can be asked. The third choice is likely to have few returns.

The distribution of the survey should cover all zoning areas, particularly residential areas, heavily travelled corridors, and airport areas. The sampling should be as random as possible. The more samples the better.

The questions should be simple, brief, and clear. They should be designed to determine whether there is a noise problem, what the sources are, and whether there is public support for control of them. In this way, there will be some guidance about what ordinance provisions are required, what the effect of noise is on responder, and where enforcement may be required.

The results of informal surveys are often surprising; noise is often ranked much higher than expected.

It is always tempting to make a comprehensive survey with sound level meters over the entire community. Good surveys are very time consuming, costly, and require extensive planning prior to implementation. What results is a general noise map of the community. If the intent of the noise ordinance is to result in active monitoring, such a map is useful. If the intent of the ordinance is complaint response based (passive), the map can only be used to confine that

the location of the response is reasonable. In most communities, a formal sound survey is not justified.

## Assess the Noise Problem

One weakness of a survey is that it accounts only for the present. Communities are dynamically changing and new sources of noise originate continually. Examples are new highways, permits for new residential areas, new factories, or even a shooting range. Consultation with the planning staff is vital to insure that such future changes are taken into account when assessing the noise problem. In addition, it is necessary to keep abreast of changes in federal and state laws and regulations.

Both the complaint statistics and questionnaire results should provide a good indication of what needs to be done, if anything. The first step is to develop a list of the sources, assess the ability to control them, technically, economically, legally, and politically. The word “technically” may include the purchase of sound level meters and the training of personnel to run them, or the ability for a possible noise offender to reduce their sound output. The word “economically” implies costs to the community and costs to any possible noise offender for correcting their noise problem. The word “legally” implies that any enforcement of a prospective noise offender must meet other laws that may be applicable. The word “politically” includes resistance by powerful community members as well as bureaucratic inertia of the government itself. The key official is vital in the latter consideration.

Connect with the state to determine the effectiveness and the degree of enforcement of their statute as they may apply to your community. Connect with other communities that have programs with similar noise problems to determine how they have overcome any resistance to controlling them, how they evaluated the improvement resulting from noise control, and how they enforce their provisions.

For large communities, development of a noise impact map is helpful for active monitoring. It also defines those areas where noise control is most important. For example, in some residential areas, most residents will keep outside dogs resulting in a number barking problems. Overlaying a community map with CNEL or  $L_{dn}$  (Appendix C.10) contours is helpful but is very time intensive and expensive and is recommended only for very large communities. It is not really needed to assess the noise problem. Have a volunteer mark on the map the locations of the complaints and any strong responses from the questionnaire. This would help to define any areas that would need active monitoring and would show citizens that the community cares should the ordinance go into effect.

At this stage, it is best to define the noise problem, its extensiveness and intensity, and which sources have been cited by the citizens. The next step is to relate this information to any adverse effects it may have on people.

## Develop Health and Welfare Goals

Typically, complaints express annoyance with a particular noise source without defining any specific adverse health or welfare impacts (annoyance is, of course, one negative impact). The task here is to define which impacts are associated with which sources and how intensive they are.



Chapter 3 includes a list of possible adverse impacts on citizens. Other documents should have been collected from the lists provided in the Collect Information Section above. Many EPA documents include even more information on noise impact, especially the document: Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety EPA 550/9-74-004.

It will be necessary to examine each of the noise sources cited and determine the health and welfare effect they have on the listeners. From that it should be possible to estimate both short and long term goals.

## Develop Recommendations

Since most communities have some form of noise ordinance, the first task is to review any existing ordinance for adequacy to control the noise problems that have been defined. It should now be possible to examine the ordinance provisions in Chapter 6 and develop a tentative list of those noise sources that are applicable. The health and welfare benefits for each item should be listed. For example, condominium noise problems should list lack of speech interference during the day and improvement of sleep during the night. The approximate methods for addressing each problem should be included. For example, whether sound meters are required, or whether vehicle stops are required. Along with each item should be the most likely agency to enforce the provision. The relative importance of controlling each item should be listed. It may only be possible to convince the decision makers that the most important ones need to be addressed. Although evaluation of cost and manpower requirements are critical, it is premature to provide definitive numbers until some decisions about which sources are to be controlled.

## Verbal/Written Report to Decision Makers

With a cogent set of recommendations, approved by the key official, a meeting should be set up with those critical to the decision. It should not be a public meeting as nothing firm has been decided. Attendees should be members of the study group, the key official, any municipal departments affected by activation of any of the recommendations, and the decision makers.

The report should include a brief summary of the activities that have led up to the meeting as well as the pertinent facts supporting the recommendations. Rank ordering the recommendations will permit the decision makers to make a choice of what they consider important and necessary at the present time.

If the recommendations include action toward modifying an existing ordinance or creating a new ordinance, some important aspects of the report should be included:

- If economics is a problem, or there is resistance to an ordinance, suggest that the health and welfare goals of the community can be met over time by successive modifications to the ordinance or relaxed initial enforcement.
- Make only a very general argument for a benefit/cost ratio that is acceptable since costs cannot be determined until choices about enforcement have been made. Those choices should be deferred until a draft ordinance is written.
- Submit a complete list of problem noise sources. It is easier to reduce a list than to expand it later.
- Mention other communities that have successfully addressed the same problems.



- Point out that it is technically feasible to reduce the noise impact of the sources, and note those that can be controlled with the least effort.
- Note that the federal government has placed the effort for noise control with states and communities, so it is unlikely that any other agency will solve the problem for them.
- Mention the amount of citizen support for control of noise.

Any presentation should be supported by a city map indicating the areas where complaints have been made. If there are any industrial or commercial facilities that have been reported as noisy, they should also be marked.

Try to avoid discussion of sound pressure, decibels, or other technical acoustical terms. An entire meeting can be derailed by a time consuming discussion of what these terms mean. Some simple charts may suffice. If the use of a sound level meter is to be recommended, it is best to have a demonstration of interested parties outside the meeting

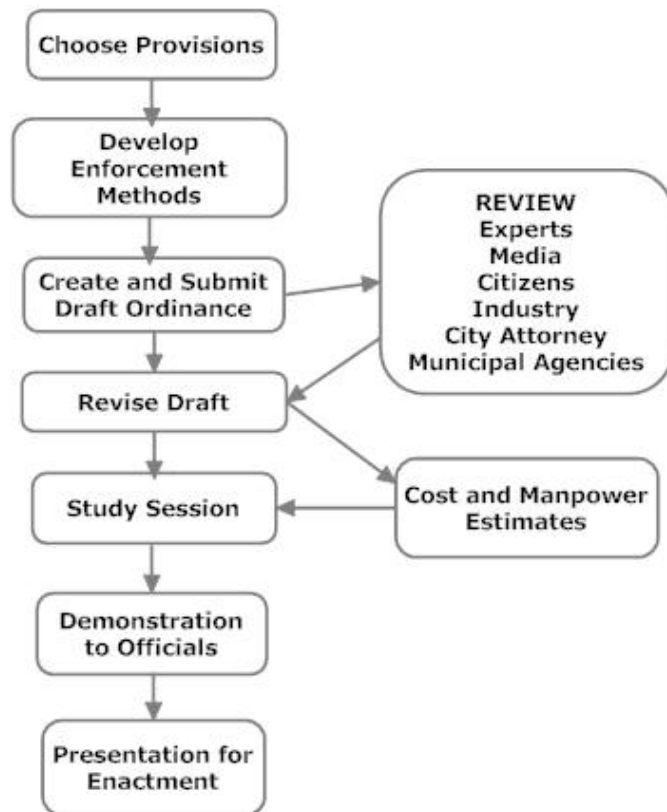
The output of the meeting is either termination of activity or guidance for developing the ordinance provisions.

### Phase III; Ordinance Development

Once the sources of sound that need control are determined, it should be possible to create suggested noise ordinance provisions. Chapter 6 has an extensive list with a variety of alternatives. The beginning of the chapter provides an overview of the various ways provisions can be written. Whether subjective (non-numerical) or objective (numerical), or whether it is intended to control the sound output of a sound source (emission control) or control the receipt of sound by a citizen (immission control), or whether enforcement is to be passive (complaint-based) or active (monitoring).

The primary goal is to solve specific noise problems and not address general noise control schemes. For example, solving the noise impact of refuse collection vehicles in a residential zone rather than commencing a large program by defining the overall sound level in a community.

Figure 2-4 shows the recommended steps in development of the final ordinance provisions.



**Figure 2-4. Ordinance Development**

## Choose Provisions

One type of ordinance is an *enabling (subjective)* ordinance. It establishes an enforcement agency with legal authority to control excessive noise but does not contain specific provisions. It has certain advantages since it does not require detailed knowledge of the noise problem before enactment. It tends to minimize arguments about specific sources, is more likely to be passed in the face of opposition, and allows time to develop more detailed enforcement procedures. The weakness of this type is that it requires a high degree of confidence in enforcement by the city agencies and the city council and can result in protracted arguments by cited offenders about the vagueness, or arbitrary enforcement, of it. Article VI of Chapter 6 is an example.

Another type of ordinance is the *specific (objective)* ordinance. This type establishes specific goals for its provisions, such as sound level limits and curfews. The particular items in the ordinance simplify the choice of enforcing agency or agencies. It gives the enforcing agency much more detailed guidance on the intent of the city council. It does require training and in most cases, sound level equipment. The weakness of this type is that it requires considerable forethought (and time) to avoid adding levels and numbers that are unrealistic or unenforceable. Changing an ordinance later is a difficult process. One purpose of this document is to avoid that pitfall.

This document includes elements of both types of provisions. The type chosen should be specific to the noise problems, so the entire ordinance is a hybrid of these types. The subjective aspect has been made more quantitative by including terms such as “plainly audible” and “noise disturbance”.

Chapter 5 includes preliminaries to the ordinance. It provides a declaration of findings that can be modified to be acceptable to the local community. It includes a long list of definitions, not all of which need be included in the ordinance. There are certain definitions that should be included regardless of the ordinance provisions chosen; they are listed in the chapter. The other definitions are tied specifically to the chosen provisions and the required definitions for them are to be found in each of the provisions of Chapter 6.

Chapter 6 includes an extensive list of noise ordinance provisions that have been used by other communities or have been developed from research on how noise problems are to be solved. At this point it should be possible to choose those that will resolve the defined noise problems. Most of the provisions have alternative choices that will depend on how the community views enforcement. In some cases alternatives can be created for those that do not have them. . The *Comment* section of each provision describes the meaning and intent of the provision as well as what other communities have done. The *Recommended Values* section has numerical values that seem reasonable, based on what states and communities have done.

The first provision (Article VI, Noise Disturbance Prohibited) should be in *every* ordinance. It has considerable legal validity and becomes a backup to the more specific provisions later in the chapter. Because it is completely subjective and general, the other provisions add more specificity to it. The more specific a provision is, the easier it is for a potential violator to understand what is expected of him. It also avoids the “vagueness” argument (Section 4.3).

Of all the other provisions the most important two are the ones that relate to land use (Article IX of Chapter 6) and motor vehicles (Article X of Chapter 6). Appendix A is needed as a support for Article IX and should be consulted; it lists a number of states and communities with

specific provisions on land use. Appendix B supports provision 9.1 of Article X and should be consulted.

The provisions should first be chosen based on health and welfare considerations and should be followed by considerations of the reality of enforcement. This part of the process is the most time consuming.

The provisions chosen must be compared to state and federal laws for possible conflicts. If there are adjacent communities with a noise ordinance provisions similar to those proposed, it is important to consider them in order to avoid any discontinuities in levels and time limits between communities.

Note that this document does not include any building constructions standards, nor should any be included in a noise ordinance. They should be included in building codes. The difficulty here is that some noise problems occur in apartments and the walls are insufficient to provide adequate acoustical separation. Because the NCO cannot be a noise consultant, his only recourse would be to report continual problems in this area. The issue of airport noise is complex. It is a federal issue associated with both commercial and military airports, and covers widely impacted areas that are not easily integrated into a local noise ordinance.

## Decide on Enforcement Methods

In some communities, consideration of who is to enforce any ordinance was considered before the concern about citizen health and welfare. In some cases, opposition of the police department to being the enforcing agency killed the process. If the provisions have been chosen as per the previous section, the enforcing agency becomes easier to define. Although vehicle monitoring can be done by a volunteer, it requires a person with legal authority to stop a moving vehicle.

With a list of prospective provisions it is possible to tentatively describe the best agency to do the enforcement. Very little about enforcement is included in Chapter 6. Chapter 7, however, is solely concerned with enforcement. It provides some information on enforcement officials and recommendations on general enforcement procedures for each of the provisions in Chapter 6. Appendix E describes the desired characteristics of sound level meters.

An extensive discussion is made of the measurement conditions. The federal government and several states have very strict rules on how sound measurements are to be made. They are actually intended to measure sound output, mostly of motor vehicles, but have also been applied to other measurements. This is not the purpose of a noise ordinance, so strict adherence to these rules is not beneficial; in fact it can make sound measurements difficult and frustrating.

Because auditory or sound level measurements are local to a site and specific to a noise infraction, it is not possible to provide extremely detailed guidance. It is important to insure that **no** noise control solutions are included either in the provisions or in written policy. It is not the function of a NCO to be a consultant in noise control. He is unlikely to be expert enough, and any recommendations create a liability problem for the municipality.

## Create a Draft Ordinance and get it Reviewed

If all the provisions needed to achieve the health and welfare goals have been chosen, they should be put into written form for review.

Recommended reviewers are:

- Members of the citizens group
- Members of the study group
- Any local experts on acoustics, audiology, and sound measurement
- Get permission to distribute the materials to local media
- Members of any of municipal departments that may be affected by the ordinance
- Any commercial or industrial firms that may be adversely affected by the ordinance
- The city attorney

It would be premature to involve the city council until all conflicts have either been resolved or ignored. Ignoring objections requires considerable fact justification.

Tentative assignment of enforcement tasks should be discussed. Feedback from the affected municipal departments about manpower and costs are needed.

## Revise the Draft

Reviews often result in conflicting opinions about a provision. The revision process must be an attempt to resolve them, or choosing a defensible path based on citizen health and welfare that overrides any objections. Negative opinions about technical, legal, or enforcement aspects would require further reviews.

At this point, it is important to have a nearly finished document that has high potential for enactment. Input from the key official will provide such guidance. It may require reducing the scope of the ordinance. Experience has suggested that a technically sound, legal, and enforceable ordinance of lesser scope is preferable to a larger but unpassable one. The lesser one can be amended in the future as the need for changes appears.

## Make Cost and Manpower Estimates

A detailed allocation of tasks for each provision is difficult to develop since it will be unclear how much enforcement action will be requested by the citizens and demanded by the administration. Only rough estimates can be made based on the complaint information, questionnaires, and department feedback. Breaking those estimates down to the various provisions will provide the city council with valuable information about which provisions to include in the ordinance, or which provisions enforcement is to be deferred.

## Study Session with City Council

The objective is to hone the proposed ordinance to that which is realistically achievable. Revision is likely to be necessary after a meeting with the city council. The attendees may be the same persons as those reviewing.

Vital discussion items are:

- Manpower and cost estimates

- Resolution of objections
- Intended degree of enforcement and any schedule of delayed enforcement
- Method of informing the public
- Suggest a demonstration

The issue at this point is primarily political and technical discussion should be avoided.

## **Demonstration for Officials**

A demonstration is not always necessary, but is very useful to give the city council and possibly municipal judges a hands-on feel for the procedures that would be used. It is mostly advantageous for a noise ordinance that has objective provisions. Demonstrating the use of a sound meter makes the observers more comfortable, allows for questions about their concerns, and converts a lot of the decibel (scientific) talk to realistic actions. If motor vehicle provisions are included, some demonstration monitoring of a passby may be helpful.

Some important items are:

- Avoid having people close around any microphone.
- Avoid areas with a lot of interfering background sound.
- Always use a wind screen

## **Presentation to Officials**

The intent is to have the ordinance passed on first reading. The key official should make the presentation with support from any of the municipal agencies that would be responsible for enforcement. It is likely that the city attorney has already briefed members on the legality of the proposal. Any testimony by acoustical experts or audiologists is very helpful. Since it would be a public hearing, all supporters should be encouraged to attend.

It is important to:

- Avoid getting bogged down in technical questions.
- Discuss objections that were expressed and resolved.

## **Phase IV: Ordinance Enactment**

This phase of the process is the successful result of using the guidance in this document along with the support of other communities, the work of volunteers, the key official, and is not included here.

## **Phase V: Ordinance Enforcement**

This part of the process is the successful result of using the guidance in Chapter 7 of this document along with the discussions with prospective enforcement agencies. Vigilance on the part of concerned citizens is necessary to ensure what has been promised has come to fruition.

## Noise Complaint Form

Date: \_\_\_\_\_

Name: \_\_\_\_\_ Phone: \_\_\_\_\_

Address: \_\_\_\_\_

Occupation: \_\_\_\_\_ Gender: \_\_\_\_\_

Location of Complaint: \_\_\_\_\_

Location of Source (s): \_\_\_\_\_

\_\_\_\_\_

### Source of Noise Problem

***Check all those that apply***

- ☐ Radios, television, musical instruments for private use
- ☐ Public address or exterior loudspeakers
- ☐ Public outcry for commercial purposes
- ☐ Dog and other animals
- ☐ Truck loading or unloading operations
- ☐ Construction activities
- ☐ Repairs or maintenance of motor vehicles or motorboats
- ☐ Aircraft or airport operations
- ☐ Places of public entertainment (open or closed facilities)
- ☐ Impulse sounds, such as explosions, blasting, or firearms
- ☐ Powered model vehicles. Specify locations: \_\_\_\_\_
- ☐ Vibration
- ☐ Fixed non-emergency signaling devices
- ☐ Fixed emergency signaling devices
- ☐ Domestic power tools. Specify type: \_\_\_\_\_
- ☐ Heating or air conditioning equipment
- ☐ Swimming pool equipment
- ☐ Skeeet or shooting ranges
- ☐ Sounds within condominiums or apartments. Specify type: \_\_\_\_\_
- ☐ Stadiums or outdoor music events
- ☐ Wind Turbines
- ☐ Motor Vehicles in general
  - ☐ Autos
  - ☐ Buses
  - ☐ Fire trucks
  - ☐ Off-road vehicles
  - ☐ Vehicle theft alarms
  - ☐ Standing vehicles
  - ☐ Airboats/Hovercraft
- ☐ Large trucks
- ☐ Ambulances
- ☐ Motorcycles
- ☐ Vehicle sound systems
- ☐ Tire squeal
- ☐ Racing events
- ☐ Railroads

Remarks: \_\_\_\_\_

## Community Questionnaire Date:\_\_\_\_\_

### Demography (check items)

Dwelling type: ☐Single family ☐Multifamily ☐Apartment ☐Condominium

Years at residence: ☐ <1 ☐ 1-5 ☐ 5-10 ☐ >10

Gender: M F Age: ☐ <20 ☐ 20-30 ☐ 30-40 ☐ 40-50 ☐ 50-60 ☐ 60-70 ☐ >70

### Ranking of Community Environmental Problems (add rank numbers)

Air Pollution\_ Noise Pollution\_ Crime\_ Traffic\_ Other\_\_\_\_\_

### Reaction to Noise (circle choice)

Y N Are you annoyed by barking dogs?

Y N Are you annoyed by motorcycle noise?

Y N Do you think construction noise should be controlled?

Y N Are you annoyed by vehicle sirens?

Y N Are you more annoyed by sounds at night?

Y N Are you often awakened at night by outside sounds?

Y N Do you consider your neighborhood to be quiet?

Y N Do you consider yourself to be tolerant of noise?

### Noise sources (check items)

Do you consider the following sources of noise a problem?

☐ Radios, television, musical instruments for private use

☐ Public address or exterior loudspeakers

☐ Public outcry for commercial purposes

☐ Dog and other animals

☐ Truck loading or unloading operations

☐ Construction activities

☐ Repairs or maintenance of motor vehicles or motorboats

☐ Aircraft or airport operations

☐ Places of public entertainment (open or closed facilities)

☐ Impulse sounds, such as explosions, blasting, or firearms

☐ Powered model vehicles. Specify locations:\_\_\_\_\_

☐ Vibration

☐ Fixed non-emergency signaling devices

☐ Fixed emergency signaling devices

☐ Domestic power tools. Specify type:\_\_\_\_\_

☐ Heating or air conditioning equipment

☐ Swimming pool equipment

☐ Skeeet or shooting ranges

☐ Sounds within condominiums or apartments. Specify type:\_\_\_\_\_

☐ Stadiums or outdoor music events

☐ Wind Turbines

☐ Motor Vehicles in general

☐ Pickup trucks

☐ Police cars

☐ Snowmobiles

☐ Vehicle horns

☐ Refuse collection vehicles

☐ Engine braking devices

☐ Autos

☐ Buses

☐ Fire trucks

☐ Off-road vehicles

☐ Vehicle theft alarms

☐ Standing vehicles

☐ Airboats/Hovercraft

☐ Large trucks

☐ Ambulances

☐ Motorcycles

☐ Vehicle sound systems

☐ Tire squeal

☐ Racing events

☐ Railroads

## Chapter 3

### Noise Effects on Health and Welfare

*This chapter presents information on the effect of noise on people and may be used to: (1) determine community health and welfare goals; (2) provide justification for a noise ordinance; and (3) provide information to the citizenry on the adverse effects of noise pollution. These effects are: hearing loss, speech interference, sleep interference, performance interference, and annoyance.*

#### Introduction

One obligation of a community is to protect its citizens from adverse environmental influences. Noise is one of these factors, so this chapter addresses the recipients of noise and how it influences them; later chapters address the sources of noise. One argument against a noise ordinance is that there are other more important factors in the community to control because sound does not do *immediate serious* harm. Air pollution and second hand cigarette smoke have similar negative impacts but are routinely regulated. Noise should also be given the same consideration, as this chapter will show.

The primacy purpose of this chapter then is to provide:

- An understanding of the effects of noise on people which will enable you to recommend a list of health and welfare goals for justification of a noise ordinance.
- Information for use in educating officials and the citizenry on the effects of noise.

The major effects of noise are summarized in Table 3-1 below.

Hearing Loss [Health]	Long term Short term
Speech/Audio Interference [Health/Welfare]	Public spaces Private spaces
Sleep interference [Health]	Public Spaces Private Spaces
Physiological Effects [Health]	Pain Vertigo Blood vessel constriction Blood pressure increase Heart rate increase Increased hormone production (stress) Startle reflexes
Distraction [Welfare]	Reduced output Increased errors Recreational activity interference
Annoyance [Welfare]	Cumulative effects
Complaints [Welfare]	Cumulative effects

***Table 3-1. Health and welfare effects of noise***



## Reasons to Establish Health and Welfare Goals

Development of health and welfare goals is necessary to insure the initiation and maintenance of a successful noise ordinance.

- **The only feasible legal basis for a community's right to control noise is based on adverse health and welfare effects.**

A sound legal basis makes it simpler to convince legislators that any effort to pass an ordinance will be successful.

- **It is easier to uphold the constitutionality of a noise ordinance in a court of law if it can be shown that it is based on health and welfare concerns.**

Disturbance of the peace is well established in law and numerical standards have also been established, but disagreement about what they are, and what effect they have, still exists.

- **Well defined goals make it simpler to reach agreement between advocates and opponents of provisions for a noise ordinance.**

Very few persons will disagree with the need to prevent hearing loss, to prevent speech interference, or to prevent sleep interference. Disagreement comes in other forms. The primary one is the cost to a manufacturer or a local business to comply. Since a noise ordinance is listener-based, not source-based, gradual enforcement aimed at reaching health goals tends to show that impacts may be considerably less than anticipated.

- **Well established goals help to define the aims of an ordinance and thus the enforcement methods.**

There are numerous sources of noise in a community. If the ordinance is based on health goals, it helps to define those sources that need regulation. Once the types of sources are defined, enforcement methods can be more easily established.

- **Well established goals permit the effectiveness of an ordinance to be evaluated or to suggest changes to an existing ordinance.**

Once an ordinance is activated, the citizenry expect improvement in their acoustical environment. Many times an ordinance is passed to silence vocal citizens, with no intention of enforcement. Once that is discovered, community leaders have to respond or lose any re-election bid. An objective evaluation of an ordinance determines whether the health and welfare goals of the ordinance either has been achieved or is moving in the right direction.

## Hearing Loss

Concern about hearing loss can be divided into two time scales and three areas. The time scale concerns short and long term loss. The areas are occupational, private, and public. Although hearing loss is not a large issue in community noise ordinances, this discussion is best utilized to allay citizen fears about short term hearing loss caused by normal community noise sources.

Professionals put hearing loss into two categories: permanent threshold shift (PTS) and temporary threshold shift (TTS). “Shift” is a euphemism for “loss”. The shifts of hearing in both categories can be rapid or gradual. Generally a number of TTS events lead to a PTS event. There is another term, noise induced permanent hearing threshold shift (NIPTS) used mainly for occupational hearing loss.

### Short Term Permanent Hearing Loss

This can occur when a person is exposed to exceedingly high levels for a short time (140 dB or more). The ear drum (tympanic membrane) can be ruptured, and organs, such as the eye and internal organs, can be set into resonance causing disorientation and pain. In a community setting, the most likely situation where this might occur is blasting or weapons discharge. Losses of this type are not serious candidates for control by a noise ordinance. Municipal departments should have a policy of requiring hearing protection at licensed blasting sites and gunnery ranges.

### Long Term Permanent Hearing Loss

This is a more common occurrence but is not a *major* issue for a noise ordinance. *Continuous* environmental levels are seldom sufficient to induce long term hearing loss, although the cumulative effect of involuntary and voluntary exposure to temporary high levels can result in such loss. It should be of concern to the various municipal departments in order to protect the hearing of those employees who are exposed to high levels of sound. Citizens who voluntarily expose themselves to high levels of sound are of concern to a community but a noise ordinance can only be enforced in private facilities open to the public or in public spaces.

Persons with hearing aids to partially overcome a permanent loss can have some impact on noise ordinance enforcement. Hearing aids preferentially amplify those frequencies most important for speech intelligibility (1000 to 4000 Hz). Sources that create pure tones in this range will elicit justifiable complaints from these persons when others are not bothered.

### Occupational Hearing Loss

The Occupational Safety and Health Administration (OSHA) has a standard for the protection of employees in workplaces under the Occupational Safety and Health Act. The effect of hearing loss is progressive loss of communication, socialization, and responsiveness to the environment. In early stages, the loss is at higher frequencies and affects the ability to understand or discriminate speech. The effects of noise can be simplified into three general categories:

**Primary Effects**, which includes noise-induced temporary threshold shift, noise-induced permanent threshold shift, acoustic trauma, and tinnitus.

**Effects on Communication and Performance**, which may include isolation, annoyance, difficulty concentrating, absenteeism, and accidents.

**Other Effects**, which may include stress, muscle tension, ulcers, increased blood pressure, and hypertension.

A table of limits is provided in the code [29 CFR 1926.52(d)(1)], and is shown in Table 3-2. These are maximum allowable limits to the average sound level.

Permissible Occupational Noise Exposure Levels	
Duration, Hours per Day	Sound Level, dB(A), Slow Response
8	90
6	92
4	95
3	97
2	100
1 ½	102
1	105
½	110
¼, or less	115

**Table 3-2. Maximum allowable noise exposure in the workplace.**

The primary concern of this law is to prevent long term hearing loss. Long term is generally defined as exposure for *eight* hours per day over a *forty* year period. Although the law permits levels of 90 dB(A) for the eight hour workday, whenever the average level is 85 dB(A) or more, an employer must commence a hearing conservation program including audiometric testing and noise monitoring. Such programs imply considerable resources in funds, manpower, equipment, and technology.

Hearing loss can result in “ringing” in the ears (tinnitus). Some individuals with this condition may blame community noise sources for their problem and demand enforcement.

## Non-Occupational Noise Exposure

The limits in the OSHA law *presume* that exposure during non-working hours is much lower. Both the Dept. of Health and Human Services and the Environmental Protection Agency have developed recommended maximum exposure sound levels for non-working hours. They are shown in Table 3-3. The numbers in the table might be taken to imply that a community should attempt to reduce citizen noise induced hearing loss through a noise ordinance. These levels are not for general use in a

Non-Occupational Noise Exposure	
Duration per Day	Sound Level, dB(A), Slow Response
16-24 hours	70
8 hours	75
4 hours	80
2 hours	85
1 hours	90
30 minutes	95
15 minutes	100
4 minutes	110
Less than 2 minutes	115

**Table 3-3. Recommended maximum non-occupational sound levels**

noise ordinance. Most noise ordinances have limits in the 50 to 65 dB(A) range for residential areas (See Appendix A). The criterion for ordinances is not hearing loss, but annoyance and complaints which occur at lower levels. Provisions 7.9 and 7.21 of Chapter 6 address music events where attendees voluntarily expose themselves to excessive sound. These exposures can be regulated by a noise ordinance.

## Hearing Loss Caused in Public Spaces

There are situations where long term permanent hearing loss can occur, particularly in the operation of machinery by both public and private persons. Operators of construction equipment can incur losses over the long term (covered by OSHA). Operators of emergency equipment (police, fire, ambulance) can sustain hearing loss due to their use of sirens. It is not likely that hearing loss will occur in the surrounding community due to these events. Operation of sound systems in public places, both outdoors and indoors, can result in a temporary shift in hearing if levels are permitted to be very loud. Provision 7.2 of Chapter 6 addresses this situation. Exposure time is generally sufficiently short that both short and long term effects are difficult to measure. Community concern should be directed toward preserving the hearing of young school children who may be exposed to excessive sound levels in the course of a school day. No evidence has been found of a noise ordinance that addresses the *internal* sound levels in a school. Many communities define the exterior of schools as “quiet zones”, however.

## Hearing Loss Caused in Private Spaces

There are no community ordinances to protect the hearing of individuals in private spaces. Typical concerns are loud music by young persons. An enlightened community can express concern about the danger by an educational program to acquaint people about the long term impact of excessive sound levels, but the issue is not an item to incorporate into a noise ordinance, nor has an ordinance been found to have such a provision. The primary method of handling this situation is through regulating the sound impact on involuntary listeners.

## Speech and Audio Interference

Interference with speech due to high noise levels can have several important effects. The Federal Highway Administration uses speech interference as the basis for their Noise Abatement Criteria (See Appendix C.11.4). In situations where communication is critical (in traffic, during construction, responding to emergency alarms) loss of intelligibility can result in injury. In less critical situations, it can result in mistakes or inability to hold a continuous conversation which in turn results in annoyance and complaints. Reducing speech interference is an important health and welfare goal for a noise ordinance. The typical response for a talker in such an environment is to raise his or her voice (the cocktail party effect). Unfortunately, this does not always insure accurate communication and is acceptable for only a limited time. Audio interference (inability to hear needed signals, such as alarms or other warnings) due to high sound levels also can have important negative effects.

Studies of speech intelligibility were instituted over 60 years ago and those studies have shown that both the overall level and the frequency distribution of the sound at the listener are very important. People understand best in the frequency range from 1000 to 4000 Hz. That is

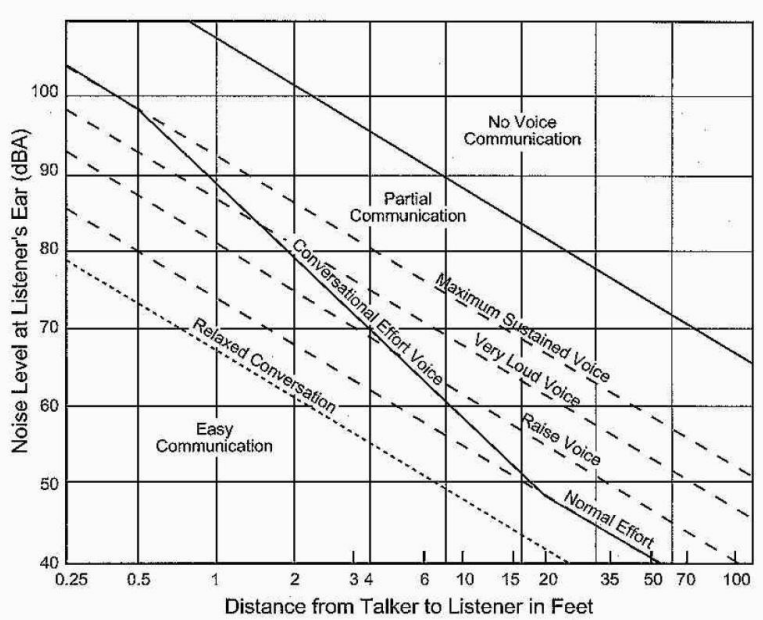
why hearing aids preferentially amplify those frequencies. Objective metrics of intelligibility exist so that speech interference can be measured or predicted (Articulation Index, Speech Intelligibility Index).

Unfortunately, they are based on some important restrictions:

- The speaker speaks English, knows the language well, and speaks clearly.
- The listener understands English, is familiar with the language, and has normal hearing.
- The frequency distribution (spectrum) of the speech at the listener is known.
- The frequency distribution (spectrum) of the ambient is known.

These metrics are used routinely in evaluating speech privacy in offices where most of the above factors are known. This is not the case in a community where these factors are not known. Instead the Speech Interference Level (SIL) has been used. It is the arithmetic average of the sound level in the 500, 1000, 2000 Hz octave bands. Figure 3-1 shows the approximate relationship between the needed voice effort and the distance from talker to listener. The chart cannot be used to establish limits on the ambient sound to which people are exposed because the SIL is very limited in frequency and applies only to speech interference. One aspect seldom taken into account is the fact that persons with a hearing loss have aids that selectively amplify the same frequencies that are accounted for in SIL. The effective SIL for them is higher.

This chart is valuable for use with the “plainly audible” terms in the various provisions. Appendix C.6 discusses in more detail how speech interference can be handled.



**Figure 3-1. Speech interference.**

## Speech Interference in Public Places

Emergency or police vehicle sirens certainly are loud enough to seriously inhibit speech communication. However, they are transient and are generally accepted by the citizenry when the vehicle is moving. They are not necessary when the vehicle is stationary, only flashing lights are needed.

Public events, particularly those that use amplified speech or music, can interfere with speech for those attending the event and for those in the neighborhood. Event attendees seldom are concerned about speech interference while those in the neighborhood are often concerned. Persons in hospitals, nursing homes, and retirement villages are particularly sensitive to speech

interference. Many of the individuals already have a hearing loss. Speech interference in educational facilities can retard the learning process of children.

## Speech Interference in Private Places

Speech interference within residential units is often the major source of noise complaints to be handled by the community. Since ambient sound level is normally low in residential zones, sirens, noisy neighbors or equipment will cause that interference both *outdoors* within the property and *indoors*. Both are problems that can and should be handled by a noise ordinance. A number of the provisions in Chapter 6 address these problems. For example, provision 7.20 addresses the indoor situation. An indirect benefit to reduce speech interference is noise control of the sources. Provision 7.17 addresses local stationary sources such as air conditioners. Article X addresses the sound output of motor vehicles. There are cases where siren use is excessive and unnecessary; siren use should be carefully controlled (See provision 10.7 of Chapter 6).

## Audio Interference in Public Places

In this category is interference caused by signaling and emergency alarms both in and out of buildings. Persons with serious visual handicaps use sound as a means of navigation and high noise levels can seriously interfere with their safety. For example, they use the audio signal at street crossings as confirmation that it is permissible to cross. Unfortunately, the Americans with Disabilities Act (42 U.S.C. Sec. 12101 *ET seq*) does not include specific reference to this situation.

## Sleep Interference

Noise can prevent the rest necessary for proper mental wellbeing and recuperation in three ways: sleep prevention, arousal from sleep, and alteration of sleep patterns. Sensitivity to noise varies between individuals, and women, particularly mothers, are considerably more sensitive than the population at large. Young children start life sleeping most of the time and appear to be insensitive to noise. Young and middle-aged adults need from 7 to 7.5 hours of sleep per day. Elderly persons, particularly women, have difficulty sleeping even without sleep interference. Insufficient sleep has a strong influence on the health and welfare of the individual.

Community noise events of sufficient level can prevent, or strongly retard, going to sleep. In suburban areas, a large noise contributor is a neighbor's barking dog. A number of events can occur in sleep that can change the pattern without complete arousal. The sleeper may not be aware of the adverse influence of this change.

## Stages of Sleep

### Waking

The waking stage is referred to as relaxed wakefulness, because this is the stage in which the body prepares for sleep. All people fall asleep with tense muscles, their eyes moving erratically. As a person becomes sleepier, the body begins to slow down, muscles begin to relax, and eye movement slows to a roll.



## Stage 1

Stage 1 (drowsiness) is the first in the sequence. There is a large reduction in bodily activity from wakefulness to Stage 1. Eyes are closed, but if aroused, a person may feel as if he or she has not slept. This stage may last for five to 10 minutes.

## Stage 2

Stage 2 (light sleep) shows intermittent peaks and valleys of brain activity. These waves indicate spontaneous periods of muscle tone mixed with periods of relaxation. Muscle tone of this kind can be seen in other stages of sleep as a reaction to auditory stimuli. The heart rate slows, and body temperature decreases. At this point, the body prepares to enter deep sleep.

## Stages 3 and 4

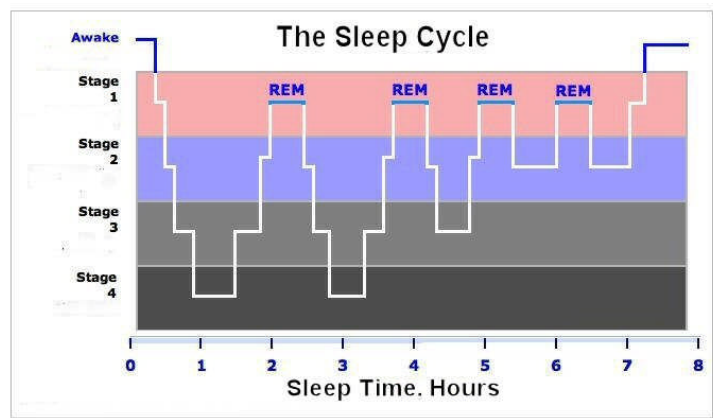
These are deep sleep stages, with Stage 4 being more intense than Stage 3. These stages are known as slow-wave, or delta, sleep. During slow-wave sleep, especially during Stage 4, records show a pattern of deep sleep.

## Non-REM

An example of a sleep pattern for a normal adult is shown in Figure 3-2. The person first passes into deep sleep and then has a succession of REM (Rapid Eye Movement) sleep periods. The depth of sleep diminishes as the sleep period progresses. Stage 1 sleep is when exterior noise sources can result in waking.

Sleep is a behavioral state that is a natural part of every individual's life. We spend about one-third of our lives asleep. Nonetheless, people generally know little about the importance of this essential activity. Sleep is not just something to fill time when a person is inactive. Sleep is a required activity, not an option. Even though the precise functions of sleep are unknown, it is known to be important for normal motor and cognitive functions. Changes that occur during sleep are readily recognized on awakening. Actually, sleep appears to be a survival requirement, so protecting the health and welfare of the citizenry with an appropriate noise ordinance is important. Table 3-4 shows some details of what happens during sleep.

With a "good" sleep, a person feels rested and more alert. Loss of sleep is associated with difficulty concentrating, memory lapses, loss of energy, fatigue, lethargy, and emotional instability. Loss of sleep results in drowsiness, unsafe driving, errors and workplace accidents. There are more than 70 known sleep disorders, the most common are **obstructive sleep apnea, insomnia, narcolepsy, restless legs syndrome, and parasomnias** (sleepwalking, sleep talking, and bed-wetting). Suffering from these disorders, individuals and particularly older citizens spend more time in Stage 1 than is suggested by Figure 3-2. About 30 to 40 percent of adults indicate some degree of sleep loss within any given year, and about 10 to 15 percent indicate that their sleep loss is chronic or severe. In addition, millions of Americans experience problems



*Figure 3-2. Sleep patterns.*

sleeping because of undiagnosed sleep disorders or sleep deprivation. Adolescents and shift workers are at very high risk of problem sleepiness due to sleep deprivation and the desynchronized timing of sleep and wakefulness, respectively.

From an ordinance enforcement viewpoint, it has been shown that levels as low as 40 dB(A) will awaken 5% and at 70 dB(A) about 30%. Intruding transient informational sounds, such as speech or music, can cause awakening or disturb the stage of sleep.

Physiological Process	Non-REM	REM
Brain activity	decreases from wakefulness	increases in motor and sensory areas, while other areas are similar to NREM
Heart rate	slows from wakefulness	increases and varies compared with Non-REM
Blood pressure	decreases from wakefulness	increases (up to 30 percent) and varies from Non-REM
Blood flow to brain	does not change from wakefulness in most regions	increases by 50 to 200 percent from NREM, depending on brain region
Respiration	decreases from wakefulness	increases and varies from NREM, but may show brief stoppages (apnea); coughing suppressed
Airway resistance	increases from wakefulness	increases and varies from wakefulness
Body temperature	is regulated at a lower set point than wakefulness; shivering initiated at a lower temperature than during wakefulness	is not regulated; no shivering or sweating; temperature drifts toward that of the local environment

*Table 3-4. Examples of sleep activities*

## Common Recommendations to Reduce Sleep Interference

Self-help documents always contain a list of things to do to alleviate noise that interferes with sleep. Several of these are listed below.

- Close the window.
- Turn on music.
- Think of something else; distract yourself.
- Count down until sleepy.
- Add more pillows.
- Change rooms.
- Wear earplugs.
- Add sound masking.
- Ask the person making the noise to be quiet.

It is not clear how effective most of these recommendations are, and they may be applicable only to specific noise sources. These recommendations themselves may result in stress and annoyance which is not beneficial to the listener's health and welfare. (Why should I have to close the window and add earplugs for my noisy neighbor?) The addition of sound masking is the most effective passive response; these devices are commonly available and have been used in



commercial open offices for over 40 years. The last recommendation may make things worse if the person is undisciplined; the sound could get louder until the police arrive.

The one recommendation never found is: Advocate an effective noise ordinance.

## Sound Levels that can Change Sleep Stages

Much of the sleep interference information relating to sound levels is sufficiently imprecise to leave questions in the non-expert. Table 3-5 shows an example provided in an EPA document.

Initial Stage of Sleep	Sound Level to cause a change in sleep pattern.
REM	30 to 90 dB(A)
1	30 to 40 dB(A)
2	30 to 40 dB(A)
3	50 DB(A)
4	80 dB(A)

***Table 3-5. Range of sound levels required to change a sleep pattern.***

Note that even low sound levels can be a cause of change in sleep patterns, except when a person is in deep sleep. The sound level to cause a change in sleep stage must be at least 5 dB above the existing ambient so the existing ambient level and spectrum contour plays an important role that is not included in the table. This is one reason why home sound masking systems are used to create a raised steady ambient level. Since community night levels may range from 45 to 55 dB(A) and older persons spend more time in Stage 1 sleep, it is not surprising that sleep interference complaints come from them. Children are less sensitive to sleep interference than adults. Women tend to be more sensitive to sounds than men. Ill persons tend to be more sensitive than healthy persons.

The time history of sound is important. Impulsive sounds tend to create a more significant change than slowly changing levels such as an automobile passby. Brief non-impulsive sounds are less important than longer term intrusive sounds. The higher the information content of the sound, the more likely is a stage change to occur. Mothers with small children are hypersensitive to changes in sound level. Habituation occurs over time to repetitive sounds that are non-threatening. Because of this large number of factors which can interfere with sleep, the range of levels in the above table is not helpful in developing criteria for noise ordinance provisions. The importance of the table lies in the fact that extremely low levels can cause sleep interference; this can be used to counter those that wish to set land use levels (See Appendix A) at high levels to accommodate noise makers.

## Performance Interference

When sounds are louder, time-varying, and considered unnecessary by a listener, distraction and annoyance occurs. The noise disturbance reduces the efficiency with which personal, or business, tasks are performed. Sound masking is used to reduce the time-varying effect in commercial facilities which reduces the distraction associated with fellow employee conversations. Speech interference is a strong contributing element to performance reduction.

Performance interference is often cited as a negative health or welfare concern. Unfortunately, this interference is very difficult to quantify except through the annoyance it creates.

## Physiological Effects

Persons exposed to noise are often concerned about effects beyond hearing loss. Among them are physical pain, vertigo, blood vessel constriction, blood pressure increase, heart rate increase, stress, interruption of feminine cycles, and startle reflexes. All of these factors can have a detrimental influence on the health of citizens and need to be addressed. Most are rare occurrences in most communities however. Physical pain requires sound levels near 140 dB not encountered in a normal community. Vertigo and related symptoms can occur at levels over 120 dB, again an unusual event in a normal community. The lowest sound level found to create physiological changes in a person is around 70 dB(A), where very slight changes in skin resistance, heart rate and vasoconstriction occur. Since outdoor community noise levels commonly exceed that level for a long time, there is a small but clearly negative influence on persons exposed. It appears that most noise ordinances do not address this health effect specifically. As with performance loss, the effect is made manifest by annoyance.

## Psychological Effects

This section concerns the psychological response to noise. This aspect is most important in the majority of community noise impacts. Other health effects noted above may be the cause, but this effect is one experienced by city officials in the form of complaints.

## Common Questions about Sound

When responding to noise intrusions, people implicitly ask themselves several questions in order to evaluate their situation. The type of question and its answer goes a long way toward understanding the response of citizens to their acoustical environment and how it is best handled by officials..

### **Is the sound made by me or made on my behalf?**

Noise is often described as the sound made by other people. Our own sounds are always more acceptable. For example, a person who frequently mows his own lawn may complain about the noise created by his neighbor's mower but not that of his own. This, of course, is not generally true since there are a number of products advertised as being quiet in response to owner's complaints. It is critical for citizens to be convinced that noise control efforts are made on their behalf and that responsible citizens control their own sound making.\.

### **Is the sound "normal" for this environment?**

When all encounters with a noise situation are the same, people grow to accept it, provided the level and duration is such that it can be acceptable. High levels at football games are considered normal while only low levels are normal at home. Most "normal" sounds around a home are reasonably continuous and non-impulsive. Temporary changes of level are generally **not** considered normal.

**Is the sound necessary and can anything be done to control it?**

Even though a noise may not be normal, it may be accepted if the listener believes that nothing *should* be done about it. For example, police or ambulance sirens are accepted because they are believed necessary. However, response is negative when a person believes nothing *will* be done to a noise that *can* be controlled. Neighbor's barking dogs are one example. When a person believes that nothing *can* be done to control a noise, there is a spectrum of responses from reluctant acceptance (airports) to repetitive complaints. In every case, stress is a byproduct.

**Does the sound have meaning?**

Sound with high information content (speech, music) is more likely to be unacceptable than sound that has no meaning (broadband noise). Loud parties, loud music, even bells and chimes, are examples of sounds that create more negative response than a neighbor's lawn mower (at the same level).

**Is the sound frightening?**

Sounds that change abruptly startle listeners (impulsive sources), particularly if they are at high levels and unexpected. The response is uniformly negative. When community activities require impulsive sounds, such as blasting, informing the citizens is a very helpful way to create acceptance. Indiscriminant use of vehicle horns is another example.

**Will the sound have an adverse effect on my health?**

Most persons are aware that regulations against high noise levels in the workplace exist. There are numerous articles that discuss the health effects of noise. With the current emphasis on health care, many have complaints about headaches, dizziness, nausea and even disruptions of biological functions caused by noise. While the manifestations may be real, it is not clear that eliminating the "noise" would solve the problem. A seminal work on the effect of noise on people by K.D. Kryter had this to say:

*"The general finding that the performance of the more anxious personality types is more affected by noise than that of nonanxious types would attest to the existence of a stimulus-contingency factor. In terms of learning or conditioning, the task becomes disliked and is performed relatively poorly because it is related to or contingent upon the aversive noise."*

**What is the pitch of the sound?**

Sound with a great deal of bass (low frequency) is normally associated with something large and powerful. Sound with a great deal of treble (high frequency) is associated with small or delicate objects. Generally, high pitched sounds are psychologically less acceptable than low pitched ones at the same hearing level (Figure C.4 shows hearing sensitivity). The bark of a small dog is but one example. Pure tones (whistling sounds) are always less acceptable than other sounds. Sirens are examples.

**Is the time of day appropriate?**

Persons are most active during the day and are willing to accept more noise intrusions than they would in the evening or night. After the work day, exterior activity levels tend to lower and acceptance diminishes. Near time for bed, acceptance diminishes further and continues during

the night hours. Noise ordinances must contain provisions that follow this diurnal sequence.

## Distraction

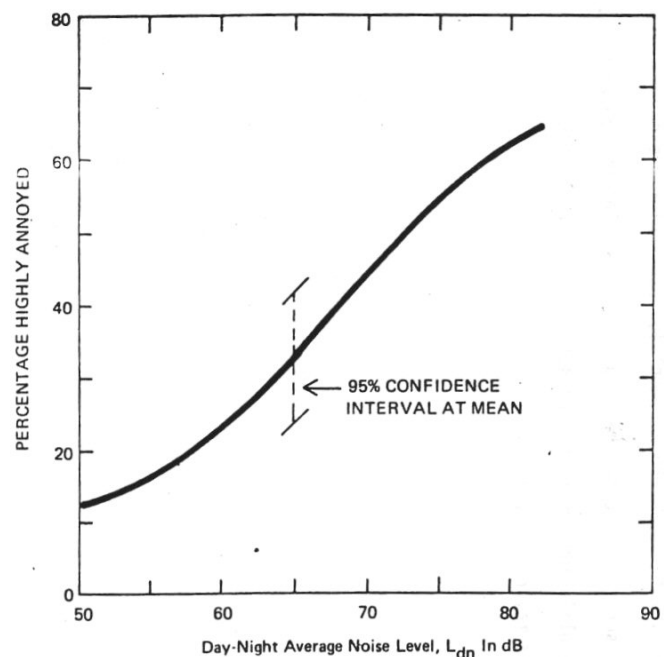
A listener's mind is attracted to time-varying sounds. The acoustical environment has changed and there is an effort to understand its nature. The more meaningful the sound, the more the distraction. The resultant distraction reduces performance at any task, and may interrupt conversations or reading. If the sound is not acceptable, the response is negative.

## Annoyance

Annoyance is always the cumulative result of all the items listed in the previous sections. Irrate citizens, annoyed by noise, are the most frequent impetus for the initiation of a noise ordinance and the continual enforcement of it. Although the action for initiating a noise ordinance is restricted to a very small percentage of the population, most annoyed individuals do not register complaints until cumulative noise intrusions are no longer acceptable.

Figure 3-3 shows the results of surveys that indicate in a general way the relationship between *average* noise levels and citizen annoyance. The use of "average" relates to the fact that the level is an average of many sources with different durations and sound spectra taken over a large area and a long period. Charts like this are useful at the federal level for control of sound sources such as airports but are not necessarily directly applicable to a local community. Community noise ordinances are directed at annoyance over *specific* noise problems. The chart does provide support for setting the maximum sound levels permitted in land use zones. For example, maxima in the low 50's might result in low levels of annoyance in residential zones. See Appendix A for examples of existing noise regulations.

A survey was taken in a smaller community to determine which sound sources created annoyance. The results are shown in Table 3-6. Not surprisingly, motor vehicles were most important, topped by motorcycles (probably unmuffled). In another community, sirens and barking dogs were at the top of the list. If Figure 3-3 is used, it would indicate that levels around 50 dB(A) were the average for that community. This shows the danger of extrapolating from annoyance about a specific noise source to generalized community levels.



**Figure 3-3. The relationship of community noise levels to citizen annoyance.**

NOISE SOURCES RANKED BY PERCENT OF URBAN POPULATION HIGHLY ANNOYED		
Rank	Source	percent
1	Motorcycles	11.7
2	Large Trucks	6.9
3	Autos	6.5
4	Construction	5.8
5	Sports Cars	5.4
6	Helicopters	4.0
7	Constant Traffic	3.9
8	Airplanes	3.4
9	Small Trucks	2.8

**Table 3-6. Rank ordering of community noise sources.**

## Complaints

Complaints are the active stages of annoyance, which in turn are the results of health and welfare impacts. Since most noise ordinances are complaint based, it is important to estimate the relationship between annoyance and complaints; annoyance is a better indicator of the actual impact. It is important for decision makers to be aware of this difference. Surveys have shown the approximate relationship between the percent of people annoyed and the percent of people who complain to authorities. Table 3-7 clearly shows that complaints are not the best indicator of adverse health and welfare effects on the community.

A balloon was raised by the US EPA over the city of Boulder, Colorado at a height of 500 feet. A microphone and telemetry device was attached to the balloon in order to radio the sound spectrum to a ground station. The city at that time (1974) had a population of about 50,000 inhabitants. Listening to the sound revealed three significant sources of community noise. The most significant was the sirens of government vehicles (police, fire, and medical). The second was barking dogs and the third was the sound from poorly, or unmuffled, vehicles, primarily motorcycles. Only the latter two sounds resulted in complaints.

Several states and communities kept statistics on the types of complaints lodged with authorities. A sample of one taken in the 1970's is shown in Table 3-8 on the next page. The state of Connecticut kept the best records, followed by Boulder, Colorado. It is clear that the statistics for the other communities were less detailed. The results compare favorably with the balloon data.

Percent Annoyed	Percent Complaints
10	0
18	1
22	2
32	5
43	10
52	15
60	20

**Table 3-7. Complaints vs. annoyance.**

Several results are significant:

- Noise is not only a problem in large communities, but also in small communities.
- Motor vehicle sound is a significant contribution to noise pollution, particularly, unmuffled motorcycles. That appears not to have changed with time.
- Barking dogs was, and still is, a noise problem in both urban and suburban communities.
- The noise problem 40 years ago was significant. Although many vehicle sound sources now have improved muffling, increase in the number of sources has more than offset it.
- Official sirens were a source of complaint in Florida, but did not appear in other statistics. It is likely that annoyance occurred elsewhere, but the assumed need for them outweighed the need to respond to complaints.

Noise Source	Lakewood, CO	Boulder, CO	London, Ont.	Washington State	Connecticut	Florida	Total
Motor Vehicles	18					52	70
Motorcycles		268	55	20	346		689
Automobiles		235	50	14			299
Trucks		226	43	12	237		518
Buses		163		4			167
Motorboats					72	3	75
Snowmobiles				2	133		135
Highways					171		171
Races				2	63		65
Vehicle Sirens				6	56	170	232
Aircraft				7	65	115	187
Helicopters				3	77		80
Railroads		65	20	3		2	90
Dogs	75	195	36	12	294		612
Music					156		156
Loud Parties					117		117
TV, Stereos			24		103	158	285
Home Tools				5	55	6	66

*Table 3-8. Some complaint statistics.*

## Summary

Although improved health and welfare of the citizens is the reason for a noise ordinance, it takes some analysis to uncover those effects. Complaints are the data with which a community has to work (excepting active monitoring). When developing or modifying a noise ordinance, it is vital that a solid relationship between health and welfare effects and how much regulation is to be required. The relationship can be through interviews, questionnaires, or complaint analyses. The importance of this was discussed in Phase II of Chapter 2.

# Chapter 4

## Legal Aspects

### 4.1 Introduction

This chapter is not a treatise on noise law. It only addresses some key issues associated with the development of a defensible noise ordinance:

- Preemption
- Constitutional vagueness
- Free Speech
- Overbreadth
- Nuisance
- Enforceability
- Confiscation

The preamble to the U.S. Constitution states “...to insure the domestic tranquility...”. It provides support for a noise control program. Samples of cases that bear on the above issues are given in the sections below. It is beyond the scope of this document to provide an extensive listing of cases. At the end of each section is a paragraph in **boldface** that relates the material to the provisions in Chapter 6.

#### 4.1.1 Owner Onus Law

If the owner of a cited vehicle cannot identify the driver within a certain time limit, he or she is held responsible. Australia is very actively applying this concept. The Anchorage, AK ordinance (15.70.020) states:

*It shall be a rebuttable presumption that the owner of a motor vehicle that violates or exceeds any provision of this chapter has caused or permitted the operation or driving of that motor vehicle.*

### 4.2 Preemption

The preemption doctrine derives from Article VI of the US Constitution which states that the laws of the federal government are the supreme laws of the land. Any federal law *or regulation* supersedes any *conflicting* state law. A federal law or regulation may *expressly* preempt a state law or community ordinance. It may also create an implied preemption. It then becomes necessary for a court to determine whether Congress has "occupied the field" in which the state is attempting to regulate, or whether a state law directly conflicts with federal law, or whether enforcement of the state law *might frustrate federal purposes*. This later statement has been used for immigration law. The federal law on this issue is explicit but not enforced. Arizona passed a similar supportive law to allow the state to actually enforce the federal law. The state is being sued by the federal government.

## 4.2.1 The Federal Government

The body of the Constitution gives the federal government only specifically enumerated powers (Article I, Section 8); all other powers are given to the states. Certain amendments, such as Amendment I (e.g., prevents abridgment of free speech), give citizens rights that local communities cannot abridge.

One part of Article I, Section 8, permits the federal government to regulate commerce “among the several states”. The Noise Control Act of 1972 (42USC§4901, et seq) was passed under this article. The Federal government has pre-emptive control over certain areas associated with noise created in interstate commerce. In particular, they have addressed aircraft, railroad, and motor vehicle sound sources that are used, or sold, in interstate commerce. Certain machine noise sources have also been included since they are also sold in interstate commerce. A partial list of the regulations is given below:

- 40 CFR 201 Noise Emission Standards for Transportation Equipment: Interstate Rail Carriers. Limits locomotive sound levels. Excludes street, suburban, or interurban electric railways.
- 40 CFR 202 Motor Carriers Engaged in Interstate Commerce. Limits sound levels of vehicles 10,000 lbs GVWR or more.
- 40 CFR 203 Low Noise Emission Products. Defines requirements for low noise emission products.
- 40 CFR 204 Noise Emission Standards for Construction Equipment. Limits sound levels of portable air compressors.
- 40 CFR 205 Transportation Equipment Noise Emission Controls. Limits sound levels of motorcycles, medium and heavy trucks. Includes tampering and labeling regulations.
- 40 CFR 211 Product Noise Labeling. Requires labeling of noise control products regulated by federal regulations.
- 42 USC 4910 Enforcement. Provides penalties for violation of labeling requirements or emission standards.
- 42 USC 4911 Citizen Suits. Permits citizen suits against any person, including government agencies that violate any noise control requirement.

Aircraft noise regulations are so extensive, and communities have so little control, that they are not listed here. States and communities may enact regulations that are the same as the federal regulations but no special local conditions can be applied without approval of the EPA or DOT. Nothing in these regulations limits the rights of states and communities to establish and enforce controls on objects that are **not** used in interstate commerce. They may also control environmental noise through licensing, regulation or restriction of the use or movement of any product, under certain conditions. For example, they may establish curfews, restrict use in residential or quiet zones or require certification or inspections. Restrictions can be applied to interstate motor carriers or rail carriers if the primary purpose of the restrictions is NOT noise control, or if the primary purpose is noise control and the restriction is approved by the EPA. For example, assigning interstate truck routes in a community to reduce noise in residential or quiet zones must be submitted to the EPA for approval. Assigning truck routes to minimize road surface loads or for the safety of children does not need approval. Loading and unloading operations of interstate trucks are not included in the federal regulations. The federal regulations



apply to the manufacture and sale of new vehicles. Most noise infractions occur long after first sale. Apparently, it is up to the states to maintain the standards in those regulations. Attempts by communities to enforce federal standards can meet with resistance. See 4.6.4 below on motorcycle noise.

## 4.2.2 The States

Amendment X of the US Constitution gives states police powers to regulate matters of public safety and health. The state normally passes some of this authority to local communities; it gives them the authority to write and enforce noise ordinances.

The initial stages of the Noise Control Act were assigned to the Environmental Protection Agency's, Office of Noise Abatement and Control, from which a number of informational documents and regulations have come. In subsequent years the office was closed with the declaration that noise is a local phenomenon best handled by states and communities. One suspects other motives since it is difficult to consider aircraft to be "local", despite the fact that the Noise Control Act states "...primary responsibility for control of noise rests with state and local governments." As a result, it is unlikely that violations of federal regulations are, or will be, enforced by the federal government until some federal office is reestablished. This suggests that state regulations at variance with federal regulations will be allowed to exist. For example, Appendix B shows some motor vehicle maximum sound levels *more restrictive* than federal regulations.

The Noise Control Act was intended to assist state and local communities with preparation of model codes, training of noise control officials, development of ambient noise standards, and writing of informational documents. The EPA model code is dated and there are no assistance programs for communities. The large array of documents is helpful in defining health and welfare goals but is not very helpful for developing ordinances.

## 4.2.3 Limited Preemption by States

States with statutes that contain certain specific provisions such as maximum sound levels for motor vehicles or land use levels imply, at least, that any community ordinance must be at least as strict as those statutes. For example, both California (Health and Safety Code Sections 46000 – 46080) and New Jersey (N.J.A.C. 7:29) have noise codes with which all provisions of the community ordinance must **not** be in conflict. Similarly, Connecticut (Sec. 22a-73) encourages communities to pass noise ordinances, but they must be approved by the state and be at least as strict as state regulations. Colorado regulates the sound of vehicles newly sold, and sets limits for sound from motor vehicles in operation, but permits counties and communities to enforce them. In many states, certain provisions, such as shooting range operations, are absolutely preemptive. Kentucky does not have explicit objective noise standards and recommends that local communities adopt noise control programs. They do require that they not be stricter than state or federal law. Maryland prohibits communities from setting noise standards more stringent than state law. Massachusetts specifically permits local jurisdictions to control motor vehicle sound. Oregon permits local jurisdictions to adopt noise control standards that are at least as strict as state standards. Vermont permits towns to create ordinances that control noise. Virginia specifically permits communities to regulate unmuffled motorcycles (§ 15.2-919).

## 4.3 Constitutional Vagueness

The US Supreme Court has addressed this issue:

“It is a basic principle of due process (Amendment V) that an enactment is void for vagueness if its prohibitions are not clearly defined. Vague laws offend several important values. First, because we assume that man is free to steer between lawful and unlawful conduct, we insist that laws give the person of ordinary intelligence a reasonable opportunity to know what is prohibited, so that he may act accordingly. Vague laws may trap the innocent by not providing *fair warning*. Second, if arbitrary and discriminatory enforcement is to be prevented, laws must provide explicit standards for those who apply them. A vague law impermissibly delegates basic policy matters to policemen, judges, and juries for resolution on an ad hoc and subjective basis, with the attendant dangers of *arbitrary and discriminatory application*. Third, but related, where a vague statute abuts upon sensitive areas of basic First Amendment freedoms, it operates to inhibit the exercise of those freedoms.” (the chilling effect).

**Two requirements for a good noise ordinance are:**

- **provide fair warning**
- **avoid possibility of arbitrary enforcement**

**Numerical (both level and time) provisions seem to meet these requirements, although they may suffer from other defects. Statements such as “unnecessary” or “raucous” leave the door open for vagueness arguments.**

**Examples of challenges to ordinances based on vagueness are given in the cases below.**

### 4.3.1 Plainly Audible

*State v. Ewing, 914 P. 2d 549, Haw. 1996*

It was found that that a *plainly audible* standard is not unconstitutionally vague.

**The expression *plainly audible* is used extensively in Chapter 6. It should be defined at a distance requirement added to avoid vagueness challenges.**

### 4.3.2 Church Bells

*Alliance Defense Fund v. City of Phoenix*

*Mark Roman Catholic Parish v. City of Phoenix*

Church carillon bells rang every hour from 8 a.m. to 8 p.m. every day and registered 67 dB at the nearest property line. It was considered a disturbance of the peace and the church leader was prosecuted and bell chimes were ordered reduced to 60 dB and on only for 2 minutes on Sundays. The sound was probably electronically amplified.

The Phoenix code states:

*“Noise of such character, intensity or duration as to be detrimental to the life or health of any individual or in disturbance of the public peace and welfare is hereby prohibited”.*

The Alliance Defense Fund filed suit against the city to have the prosecution overturned. They argued that the law was *unconstitutionally vague*. The US District Court overturned the original decision and stated that although neighbors' arguments were important, the interests of *free speech and religious expression* were more important, and that enforcement of the ordinance against any sound generated in the course of religious expression violates the First and Fourteenth Amendments to the United States Constitution.

**This ordinance did not have the two key requirements in the provision. In other cases, limiting church bell sound has been approved; the issue was the ordinance, not the church bells. The District Court, in this case, was probably prepared to accept a free speech argument by the Alliance Defense Fund had it been necessary.**

### 4.3.3 Dog Barking

*Spokane v. Fischer*, 110 Wn.2d 541, 754 P.2d 1241, 1988

This was a case of a barking dog for which the owner was cited.

The Spokane code (10.03.030) states:

*“No owner of a dog or owner or occupant of premises upon which a dog is kept or harbored may allow such a dog to disturb or annoy any other person or neighborhood by frequent or habitual howling, yelping or barking. Whoever harbors such a dog maintains a nuisance.”*

Defense argued that the provision was *constitutionally vague* and subjective. The court objected to “any” as permitting anyone to determine annoyance. They stated that it is any person or neighbor's threshold tolerance for barking which determines lawful conduct by the owner or harbored of a dog (*arbitrary enforcement*) and declared the ordinance void. They pointed out that many persons, especially the elderly and single women, purchase dogs for protection and security. This ordinance could penalize the owner whose dog barks whenever strangers or postal carriers approach the house or barks briefly every time it is let out of the house for a walk. Whether this behavior is lawful or unlawful will depend solely on the subjective feeling of annoyance or disturbance by a particular person or neighborhood. Conceivably, strangers walking by the same residence every day could file a complaint if the dog always barks at them.

**Provision 7.4 in Chapter 6, places reasonable time limits on barking, so that the dog owner, the listener and the enforcement official have a precise definition of when a noise disturbance is valid. The owner is given fair warning and the official cannot apply arbitrary enforcement.**

### 4.3.4 Place of Public Entertainment

*Tanner v. City of Virginia Beach*, 674 SE 2d 848 - Va: Supreme Court 2009

A night club was cited for excessive noise.

The Virginia Beach code (23-47) states:

*“It shall be unlawful for any person to create, or allow to be created any unreasonably loud, disturbing and unnecessary noise in the city or any noise of such character, intensity and duration as to be detrimental to the life or health of*

*persons of reasonable sensitivity or to disturb or annoy the quiet, comfort or repose of reasonable persons. The following acts, among others, are declared to be loud, disturbing and unnecessary noise in violation of this section, but such enumeration shall not be deemed to be exclusive:*

*(1) The playing of any television set, radio, tape player, phonograph or any musical instrument in such a manner or with such volume as to annoy or disturb the quiet, comfort or repose of reasonable persons...*”

The defendants alleged that the ordinance is vague because it fails to provide citizens with "fair notice" regarding what conduct is unlawful, and because the ordinance language invites selective prosecution by granting law enforcement officials the "unfettered individual discretion" to make enforcement decisions. As a result, the Virginia Supreme Court struck down the noise ordinance because it is unconstitutionally vague.

**Although the ordinance is similar to those of many communities, it contains many terms that a defendant would be able to challenge. Provision 7.9 of Chapter 6 assigns numerical values to sound levels interior to the facility and Article IX assigns numerical values to adjacent property lines, providing both fair warning and avoiding arbitrary enforcement.**

#### **4.3.5 Place of Public Entertainment**

*State of New Jersey v. Clarksburg Inn*, 375 N.J. Super. 624, 868 A.2d 112. (2005)

Complaints by local residents about loud music from a local inn resulted in enforcement by the state. One resident stated that he was in his home 270 feet from the facility with a closed window and the TV was unintelligible. Using Table C-5 in Appendix C it was likely that his level was between 55 and 60 dB(A). Since windows attenuate about 15 dB of exterior sound, the level outside his home was likely 70 to 75 dB(A) and the level immediately outside the inn was likely to be well over 90 dB(A). After numerous complaints, the inn was fined and subsequently appealed. The argument was that the law was unconstitutionally vague and overbroad. The relevant section of the Millstone, NJ Ordinance (No. 3-15) stated:

*a. Radios; Televisions; Phonographs. The playing, use or operation of any radio receiving set, television, musical instrument, phonograph or other machine or device for the producing or reproducing of sound in such manner as to disturb the peace, quiet and comfort of neighboring inhabitants or with louder volume than is necessary for convenient hearing for persons who are in the room, vehicle or chamber in which the machine or device is operated and who are voluntary listeners. The operation of such a set, instrument, phonograph, machine or device so that it is clearly audible at a distance of one hundred (100') feet from the building, structure or vehicle in which it is located shall be prima facie evidence of a violation of this section.*

They argued that a “constitutionally sound noise ordinance contains objective criteria for definitions and enforcement, such as sound decibel levels”.

The appeals court noted that the ordinance failed to define “clearly audible, so the dictionary definition was used. They noted that a “decibel provision in a municipal noise ordinance is not constitutionally vague”. They decided:

Millstone Ordinance No. 3-15 was based on objective criteria after a balancing of the right of the Inn to conduct its business and the right of citizens within 100 to 600 feet from the Inn to listen and watch television in the middle of winter with their windows closed because the music from the band was too loud and infringed on the right of those citizens to be free from excessive noise.

We hold that (1) the Ordinance is neither vague nor overbroad and, therefore, not violative of the Fourteenth Amendment; (2) the plain meaning of the language of the Ordinance is in compliance with the law that we previously set forth in *Holland, Bynum, Powell and Friedman*; (3) reasonable people are able to understand the proscriptions that are set forth in the Ordinance; and (4) the Ordinance, as applied, used a reasonableness standard in its application. The Law Division judge properly considered the reasonableness of the Inn's conduct when balanced against the objective right of nearby citizens to be free from the nuisance of excessive noise as proscribed by the Ordinance. Defendant's conviction was based on substantial credible evidence in the municipal court record.

**Once again the use of numerical sound limits is declared constitutional. The use of “clearly audible” is also supported, but with the condition that a distance is added. It is important that the distance be reasonable and defensible.**

#### 4.3.6 Sidewalk Assembly

*Coates v. Cincinnati, 402 U. S. 611 (1971)*

In this case, the ordinance punished the sidewalk assembly of three or more persons who "conduct themselves in a manner annoying to persons passing by. . . ." The Ohio Supreme Court affirmed the punishment.

The US Supreme Court addressed the word “annoyance”:

“The ordinance prohibits, *inter alia*, ‘conduct . . . annoying to persons passing by.’ The word ‘annoying’ is a widely used and well understood word; it is not necessary to guess its meaning. ‘Annoying’ is the present participle of the transitive verb ‘annoy’ which means to trouble, to vex, to impede, to incommode, to provoke, to harass or to irritate. We conclude....that the ordinance clearly and precisely delineates its reach in words of common understanding. It is a precise and narrowly drawn regulatory statute [ordinance] evincing a legislative judgment that certain specific conduct be .... proscribed.”

The US Supreme Court held:

“We are thus relegated, at best, to the words of the ordinance itself. If three or more people meet together on a sidewalk or street corner, they must conduct themselves so as not to annoy any police officer or other person who should happen to pass by. In our opinion this ordinance is *unconstitutionally vague* because it subjects the exercise of the right of assembly to an unascertainable standard, and *unconstitutionally broad* because it authorizes the punishment of

constitutionally protected conduct. But the vice of the ordinance lies not alone in its violation of the due process standard of *vagueness*. The ordinance also violates the constitutional right of *free assembly* and association. Our decisions establish that mere public intolerance or animosity cannot be the basis for abridgment of these constitutional freedoms.”

**The ordinance and ones like it have been replaced by the city with more modern provisions. The word “annoyance” was accepted by the court and is embedded in the definition of “noise disturbance” (3.25 of Chapter 5).**

#### **4.3.7 Sidewalk Assembly**

*Cox v. Louisiana*, 379 U. S. 536 (1965)

In this case, protesters were convicted of disturbing the peace, one element of which was the sound they made. It was upheld by the Louisiana Supreme Court.

The Louisiana Statute (La. Rev. Stat. § 14:103.1 (Cum. Supp. 1962) read:

*"Whoever with intent to provoke a breach of the peace, or under circumstances such that a breach of the peace may be occasioned thereby . . . crowds or congregates with others . . . in or upon . . . a public street or public highway, or upon a public sidewalk, or any other public place or building . . . and who fails or refuses to disperse and move on . . . when ordered so to do by any law enforcement officer of any municipality, or parish, in which such act or acts are committed, or by any law enforcement officer of the state of Louisiana or any other authorized person . . . shall be guilty of disturbing the peace."*

The US Supreme Court held:

“There is an additional reason why this conviction cannot be sustained. The statute at issue in this case, as authoritatively interpreted by the Louisiana Supreme Court, is *unconstitutionally vague* in its *overly broad* scope. The statutory crime consists of two elements: (1) congregating with others "with intent to provoke a breach of the peace, or under circumstances such that a breach of the peace may be occasioned," and (2) a refusal to move on after having been ordered to do so by a law enforcement officer. While the second part of this offense is narrow and specific, the first element is not. The Louisiana Supreme Court in this case defined the term "breach of the peace" as "to agitate, to arouse from a state of repose, to molest, to interrupt, to hinder, to disquiet." Both definitions would allow persons to be punished merely for peacefully expressing unpopular views.”

**This is an example of singing and clapping that was not considered a “breach of the peace”. There was no noise ordinance in place (such as Section 7.1 of Chapter 6 in this document) that would legally restrain the sound level to acceptable levels.**



## 4.4 Free Speech

Amendment I of the Constitution states:

“The Congress shall make no law ..... abridging the freedom of speech...”

Clearly, there are several aspects to speech. There is content (“FIRE”, preaching), level (unamplified, amplified), broadened definitions (music, church bells), mode of transmission (voice, printed), and location (private, public). As a result, the interpretation of this amendment must be made, case by case, by the courts. These interpretations must be integrated into noise ordinances. Content cannot be part of a noise ordinance, but amplification, music, bells, voice level, and locations can be included. Thus a person might be annoyed or disturbed by the content of a person’s speech, but it cannot be enforced under a noise ordinance.

Time, place, or manner restrictions must:

- be content neutral
- be narrowly tailored
- serve a significant governmental interest
- leave open ample alternative channels for communication

One challenge in 4.3.2 stated that the Phoenix ordinance was not “content neutral” in that it permitted music from moving sources but not from church bells. Since music has been interpreted as one form of “speech”, the ordinance erroneously excluded the church “music” but not other forms.

### 4.4.1 Car Sound System

*Holland v. City of Tacoma, 90 Wn. App. 533, 954 P.2d 290, 1998*

A car sound system owner was cited for being “audible at 50 feet”. Defense challenged the ordinance on the constitutional bases that it is *overbroad*, *vague*, and abridges his freedom of expression. The vagueness issue was based on the fact “.that an ordinary person would not know when he or she is violating this ordinance.”

The Tacoma ordinance (8.122.010) provided a definition:

*“‘Plainly audible sound’ means any sound for which any of the content of that sound, such as, but not limited to, comprehensible musical rhythms, is communicated to a person using his or her unaided hearing faculties. For the purposes of the enforcement of this code, the detection of any component of sound, including, but not limited to, the rhythmic bass by a person using his or her unaided hearing faculties is sufficient to verify plainly audible sound. It is not necessary for such person to determine the title, specific words or artist of music, or the content of any speech.”*

Subsection 3 of the ordinance states:

*“Sound from motor vehicle sound systems, such as tape players, radios, and compact disc players, operated at a volume so as to be audible at a distance greater than 50 feet from the vehicle itself.”*

The freedom of speech argument was dismissed since Holland was not trying to communicate a message, he was merely listening. The ordinance was not considered *overbroad*. The court stated that the traditional standard of unconstitutional vagueness is whether the terms of a statute are so indefinite that “men of common intelligence must necessarily guess at its meaning and differ as to its application.”

They further stated:

”This ordinance has clear guidelines. A person of ordinary intelligence knows what it means for sound to be “audible” at more than 50 feet away.....The Tacoma ordinance has a clear standard - audible more than 50 feet away from the source - and there is no subjective element such as ‘unreasonably’ or ‘disturbing’.”

**This case highlights a seldom mentioned aspect of free speech: the amendment applies only to a person attempting to send information to others not to a person merely listening. Loud parties and loud stereos are not intended for the consumption of other persons and so a free speech argument does not apply. Again this case provides strong support for the use of “plainly audible” with a distance requirement, despite the fact that the ordinance definition was not used in the provision.**

#### **4.4.2 Music in Common Carriers**

*(no citation available)*

There are two sources of sound in a common carrier: the passengers and the agency that operates the vehicle. This case is of the latter kind. In Washington DC, a regular passenger complained, alleging that the intrusive radio broadcasts infringed his Fifth Amendment “liberty” without due process of law.

The US Supreme Court ruled:

“This position wrongly assumes that the Fifth Amendment secures to each passenger on a public vehicle regulated by the Federal Government a right of privacy substantially equal to the privacy to which he is entitled in his own home. However complete his right of privacy may be at home, it is substantially limited by the rights of others when its possessor travels on a public thoroughfare or rides in a public conveyance. The “rights of others” referred to were the rights of others to listen to the radio programs. The Public Utilities Commission had made a finding that the radio broadcasts would benefit the public. Moreover, the Court found that the passengers had given their tacit consent to be subjected to the broadcasts by choosing to ride on the streetcars.”

**Provision 10.5(c) of Chapter 6 addresses sound creation within a public carrier. It requires that the sound be created by another passenger, avoiding the issue of vehicle operator sound creation. The passenger in the latter case has voluntarily surrendered his right to privacy.**



### 4.4.3 Vehicle Loudspeakers

*Kovacs v. Cooper*, 336 U.S. 77 (1949)

The operator of a vehicle loudspeaker in a public right-of-way was cited.

The noise ordinance (430) of the city of Trenton NJ stated:

*“That it shall be unlawful for any person, firm or corporation, either as principal, agent or employee, to play, use or operate for advertising purposes, or for any other purpose whatsoever, on or upon the public streets, alleys or thoroughfares in the City of Trenton, any device known as a sound truck, loud speaker or sound amplifier, or radio or phonograph with a loud speaker or sound amplifier, or any other instrument known as a calliope or any instrument of any kind or character which emits therefrom loud and raucous noises and is attached to and upon any vehicle operated or standing upon said streets or public places aforementioned.”*

Statements by the US Supreme Court were:

“The contention that the section is so *vague*, obscure, and indefinite as to be unenforceable merits only a passing reference. This objection centers around the use of the words “loud and raucous.” While these are abstract words, they have through daily use acquired a content that conveys to any interested person a sufficiently accurate concept of what is forbidden.”

“To enforce freedom of speech in disregard of the rights of others would be harsh and arbitrary in itself. That more people may be more easily and cheaply reached by sound trucks, perhaps borrowed without cost from some zealous supporter, is not enough to call forth constitutional protection for what those charged with public welfare reasonably think is a nuisance when easy means of publicity are open. Section 4 of the ordinance bars sound trucks from broadcasting in a loud and raucous manner on the streets. There is no restriction upon the communication of ideas or discussion of issues by the human voice, by newspapers, by pamphlets, by dodgers. We think that the need for reasonable protection in the homes or business houses from the distracting noises of vehicles equipped with such sound amplifying devices justifies the ordinance. We think it is a permissible exercise of legislative discretion to bar sound trucks with broadcasts of public interest, amplified to a loud and raucous volume, from the public ways of municipalities.”

They noted that the restriction was not an infringement on *free speech*, because the restriction was not on *content*. Implied in the decision was that the Sound Pressure Level was too high; the use of “loud and raucous” was upheld. The new NJ Department of Environmental Protection Model Noise Control Ordinance, Section X(D) states a more definable and less subjective provision:

*“Personal or commercial vehicular music amplification or reproduction equipment shall not be operated in such a manner that is plainly audible at a distance of 50 feet in any direction from the operator between the hours of 8:00 a.m. and 10:00 p.m.”*

**Provisions 7.2 and 10.5 of Chapter 6 have similar and well defined terminology to avoid any vagueness or free speech issues. See also Hines v. Winfree 408 Pa 128 (1982).**

#### **4.4.4 Standing Amplified Speech in a Public Place**

*Saia v. New York*, 334 U. S. 558, (1948)

Appellant was convicted of violating a city ordinance forbidding the use of sound amplification devices except with the permission of the Chief of Police.

The City of Lockport, NY ordinance read:

*“Section 2. Radio devices, etc. It shall be unlawful for any person to maintain and operate in any building, or on any premises or on any automobile, motor truck or other motor vehicle, any radio device, mechanical device, or loud speaker or any device of any kind whereby the sound therefrom is cast directly upon the streets and public places and where such device is maintained for advertising purposes or for the purpose of attracting the attention of the passing public, or which is so placed and operated that the sounds coming therefrom can be heard to the annoyance or inconvenience of travelers upon any street or public places or of persons in neighboring premises.”*

*“Section 3. Exception. Public dissemination, through radio loudspeakers, of items of news and matters of public concern and athletic activities shall not be deemed a violation of this section provided that the same be done under permission obtained from the Chief of Police.”*

The US Supreme Court wrote:

*“We hold that §3 of this ordinance is unconstitutional on its face, for it establishes a previous restraint on the right of free speech in violation of the First Amendment which is protected by the Fourteenth Amendment against State action. To use a loudspeaker or amplifier, one has to get a permit from the Chief of Police. There are no standards prescribed for the exercise of his discretion. The statute is not narrowly drawn to regulate the hours or places of use of loudspeakers, or the volume of sound (the decibels) to which they must be adjusted. Noise can be regulated by regulating decibels. The hours and place of public discussion can be controlled. But to allow the police to bar the use of loudspeakers because their use can be abused is like barring radio receivers because they too make a noise. The police need not be given the power to deny a man the use of his radio in order to protect a neighbor against sleepless nights. The same is true here.”*

A dissenting opinion wrote:

*“The appellant's loudspeakers blared forth in a small park in a small city. The park was about 1,600 feet long, and from 250 to 400 feet wide. It was used primarily for recreation, containing benches, picnic and athletic facilities, and a children's wading pool and playground. Estimates of the range of the sound equipment varied from about 200 to 600 feet. The attention of a large fraction of the area of the park was thus commanded. But modern devices for amplifying the range and volume of the voice, or its recording, afford easy, too easy,*

opportunities for aural aggression. If uncontrolled, the result is intrusion into cherished privacy. The refreshment of mere silence, or meditation, or quiet conversation, may be disturbed or precluded by noise beyond one's personal control.”

**This decision clearly permits a community to regulate the time and location of public discussion, but not the use of amplification. Since this case did not mention whether the sound was intended for listening or for broadcast to others, the contents of provisions 7.1 and 7.2 of Chapter 6 may both be relevant to this issue. In each case, the provisions in this document meet the conditions of free speech set out in 4.4 above. It also provides support for sound level limits (which implies control of amplification). The provisions in Chapter 6 do not contain sound level limits. It is not always possible for an NCO to arrive with a sound level meter during the event, or to force re-creation of the event.**

#### **4.4.5 Abortion Clinic**

*Madsen v. Women’s Health Center*

The question posed to the court was: Do the limitations imposed on noise-making by protesters constitute a breach of the First Amendment right to free speech? The US Supreme Court said “No”. The limitations placed on noise-making were necessary to insure the well-being of the patients.

**As in the school protesting case, there is an inherent right for a community to control the noise of protestors when it interferes with the rights of others. Article VI of Chapter 6 addresses this issue.**

### **4.5 Overbreadth**

The US Supreme Court addressed the issue of too much regulation by defining overbreadth:

“A clear and precise enactment may nevertheless be overbroad if, in its reach, it prohibits constitutionally protected conduct.”

As an example, in an effort to reduce noise, a nuisance provision is used and that provision is sufficiently vague so that other activities such as freedom of speech are covered by it and are prohibited.

**A large number of provisions in Chapter 6 are intended to address specific noise problems that could have been handled by a much broader set of provisions. The purpose is to avoid being overbroad as well as giving potential violators fair warning of what is prohibited and enforcers specific limits to their actions.**

### 4.5.1 School Picketing

*Grayned v. City of Rockford*, 408 U.S. 104 (1972)

The city of Rockford noise ordinance stated:

“Sec. 17-35. - Nuisance noises.

(a) *It shall be unlawful to cause or create any unnecessary or unusual noise at any time which annoys, injures, or endangers the comfort, repose, health or safety of others unless such noise is necessary for the protection or preservation of property or of the health, safety, or life of some person.*

(b) *No person owning or in possession or control of any building or premises shall use the same, permit the use of the same, or rent the same to be used for any business or employment or residential use, or for any purpose of pleasure or recreation, if such use shall, by its boisterous nature, disturb or destroy the peace of the neighborhood in which such building or premises is situated, or be dangerous or detrimental to health.”*

The ordinance was used to prohibit persons from protesting on school grounds. The US Supreme Court held that the ordinance was not *unconstitutionally vague*. The ordinance gave *fair warning*; it prohibited only actual or imminent and willful, interference with normal school activity, and was not a broad invitation to *discriminatory enforcement*. The ordinance was not *overbroad* as unduly interfering with First Amendment rights since expressive activity was prohibited only if it materially disrupted class work. The ordinance gave no license to punish anyone because of what he was saying (content neutral). Noisy demonstrations that disrupt are incompatible with normal school activities and are obviously within the ordinance's reach.

One dissenting opinion:

“Twenty-five policemen were stationed nearby. There was noise, but most of it was produced by the police who used loudspeakers to explain the local ordinance and to announce that arrests might be made.”

**This is an interesting case where the act of prohibiting noise and other activities generated more noise. Provision 7.2 of Chapter 6 does not specifically exempt official loudspeakers. The use of sirens, bullhorns, and vehicle loudspeakers by officials are generally exempted but their overuse did not escape the attention of the US Supreme Court. It is important for a community to act responsibly with their own sound generation.**

## 4.6 Nuisance

The Ohio Supreme Court distinguished the terms absolute and qualified nuisance as follows:

“An absolute nuisance, or nuisance [per se], consists of either a culpable and intentional act resulting in harm, or an act involving culpable and unlawful conduct causing unintentional harm, or a nonculpable act resulting in accidental harm, for which, because of the hazards involved, absolute liability attaches notwithstanding the absence of fault. A qualified nuisance, or nuisance dependent on negligence, consists of an act lawfully but so negligently or carelessly done as to create a potential and unreasonable risk of harm, which in due course results in

injury to another. The difference between an "absolute nuisance" and a "qualified nuisance" is not the type of interference (such as noise) or the right or injury asserted. Rather, the distinction between 'absolute' and 'qualified' nuisance depends upon the conduct of the defendant. An "absolute nuisance" requires *intentional* conduct on the part of the defendant; a qualified nuisance exists only because of the defendant's *negligence*."

Black's Law Dictionary defines nuisance as:

"That which annoys and disturbs one in possession of his property, rendering its ordinary use and occupation physically uncomfortable to him."

It defines a private nuisance as:

"...anything done to the hurt or annoyance of the lands, tenements, or hereditaments of another. As distinguished from public nuisance, it includes any wrongful act which destroys or deteriorates the property of an individual or of a few persons or interferes with their lawful use or enjoyment thereof, or any act which unlawfully hinders them in the enjoyment of a common or public right and causes them a special injury different from that sustained by the general public."

**The word "disturbance" is used extensively in the Chapter 6 provisions. Many civil cases about noise use the word "nuisance". The relationship between them is shown in the above text. The provisions in this document further restrict the meaning to "noise disturbance" as opposed to any other type (odor, dust). The information and findings in nuisance suits about noise are applicable to noise ordinances, despite the fact that they are civil suits.**

#### **4.6.1 Aircraft Operations**

*Casey et al v. Goulian et al )*

This case concerned aircraft acrobatics in Massachusetts. It was a civil nuisance action claiming noisy and dangerous stunt-airplane flights over their homes.

The Massachusetts law (310 CMR 7.10) states:

*"No person owning, leasing, or controlling a source of sound shall willfully, negligently, or through failure to provide necessary equipment, service, or maintenance or to take necessary precautions cause, suffer, allow, or permit unnecessary emissions from said source of sound that may cause noise."*

The Massachusetts Department of Environmental Protection Policy:

The policy specifies that the ambient sound level, measured at the property line of the facility or at the nearest inhabited buildings, shall not be increased by more than 10 decibels weighted for the "A" scale [dB(A)] due to the sound from the facility during its operating hours."

Noise is defined in the Regulations as "...sound of sufficient intensity and/or duration as to cause or contribute to a condition of air pollution."

Since the noise source was aircraft, defense claimed federal preemption. The United States District Court disagreed. After much legal maneuvering, the case was settled out of court with the terms of the settlement not disclosed.

**Experience with aircraft acrobatics suggests that the actions of the flyers were in violation of federal law, resulting in the settlement. It does establish that there are *some* possible controls over irresponsible aircraft by communities. Due to the lack of definitive decisions on aircraft operations, no regulatory text was inserted in Provision 7.8 of Chapter 6.**

#### 4.6.2 Motorcross Track

*Moyer, et al v. Morin et al*

A motorcross track in Kalispell, MT impacted nearby neighbors and a suit resulted. A court decision said:

“Defendants have shown an inability to regulate the use and operation of the track in a manner which does not obstruct Plaintiffs' free and comfortable use and enjoyment of their adjoining properties. For that reason it is necessary for Defendants to be compelled to remove the track completely from the property.”

The decision was based on the fact that the operation was a public nuisance. Kalispell has a disturbance of the peace ordinance which contains the words “loud and unusual”. No specific noise ordinance was in place at the time. Since then a new noise ordinance was pushed by Kalispell police, who have long warned that officers lack the appropriate power to issue citations when responding to noise complaints over a loud car stereo, muffler or party.

**A successful civil suit resulted in interest in developing a more comprehensive noise ordinance. In this case, the police were the driving force. It is also clear that the police power of a noise ordinance can be used to control noise from race tracks. Provision 10.12 of Chapter 6 addresses this issue.**

#### 4.6.3 Motorcross Track

*Angerman v. Burick, Court of Appeals, Ninth Judicial District Ohio 2003*

The owners of the track were sued by residents living in an essentially rural area fearing potential noise, odors, dust, congestion, and other offensive behavior. There were no zoning laws.

Plaintiff's expert found average levels at residences during operation were in the range 55 and 72 dB(A) depending on the site. One maximum was 92 dB(A). The Defendant's expert made use of the Day-Night Average Sound Level ( $L_{dn}$ ). See Appendix C.11.1. Since the track is not operated every hour of every day and is closed during winter months, the  $L_{dn}$  over a year apparently would meet any noise standards. The Court found the Plaintiff's expert more credible.

The court found that the Burick's commercial motocross track constituted an absolute nuisance for the reason that the Defendant's operation of the track generated excessive noise which caused a substantial and unreasonable interference with Plaintiff's use and enjoyment of



their property, all of which would be offensive or inconvenient to any person of ordinary tastes and sensibilities. They enjoined the Buricks from using the track for commercial purposes

**Provision 10.12 of Chapter 6 contains objective methods for controlling racing event noise and so meet the legal requirements for a valid ordinance. The reluctance for a community to enforce such an ordinance (based on economic aspects) makes civil nuisance action a strong backstop to the noise ordinance.**

#### **4.6.4 Motorcycle Noise**

*Everett v. O'Brien, 31 Wn. App. 319, 641 P.2d 714, (1982)*

This is a case where subjective criterion rather than a numerical sound limit was used to prosecute a violator.

The Everett, WA Municipal Code (20.08.090(B)(3)) states:

*“Public Disturbance Noises. It is unlawful for any person to cause, or for any person in possession of property to allow to originate from the property, sound that is a public disturbance. No sound source specifically exempted from a maximum permissible sound level by this chapter shall be a public nuisance noise or public disturbance noise insofar as the particular source is exempted. The following sources of sound shall be public disturbance noises and are subject to regulation under the provisions of Sections 20.08.030 through 20.08.050:*

*The creation of frequent, repetitive or continuous noise in connection with the starting, operation, repair, rebuilding or testing of any motor vehicle, motorcycle, off-highway vehicle or internal combustion engine within District 1 so as to unreasonably disturb or interfere with the peace, comfort and repose of owners or possessors of real property...”*

They also had a numerical limit on motorcycle sound so the question was: Is measurement of sound level *required* to establish violation? The city argued that requiring a police officer to promptly appear with a sound meter whenever a noise complaint is filed unreasonably restricts the City's ability to control the level of noise in the community. The court stated that since the disturbance provision explicitly included motorcycles, a sound measurement was not required. The court also stated that “A person of ordinary understanding is capable of determining when noise from his motorcycle is unreasonably disturbing the peace, comfort, and repose of others. This standard is more helpful than decibel levels to the average citizen in determining whether or not his conduct is unlawful.”

**The wording in Chapter 6 about measuring sound levels includes the phrase “which may be measured”. This avoids the defense argument that since an ordinance has objective provisions, sound measurements *must* always be made to establish a noise violation. This case also supports the use of both subjective and objective provisions in any ordinance.**

### 4.6.5 Shooting Range

*Christensen v. Hilltop Sportsman Club, Inc.* (1990), 61 Ohio App.3d 807

The complaint alleged that the noise created by the shooting constituted both a public and a private nuisance. The trial court found the shooting activities did constitute both a public and a private nuisance. The court issued an injunction permanently enjoining the club from permitting *any* shooting on its grounds at any time and closed the facility. The defense claimed that since the noise was not included in the states definition of nuisance [R.C. 3767.01(C)], the court had no jurisdiction.

The court stated:

“The law of private nuisance is a law of degree; it generally turns on the factual question whether the use to which property is put is a reasonable use under the circumstances, and whether there is an appreciable, substantial, tangible injury resulting in actual, material and physical discomfort.

From the testimony of the experts in this case, it appears that there are two kinds of noise—pure noise and relative noise, much like the legal distinction between an absolute and a qualified nuisance. Both experts testified that at a certain level, around *eighty decibels*, sound becomes too loud for people to tolerate regardless of the circumstances. In this case, the evidence presented revealed that the sounds from the gun club never reached this level, that the level only occasionally reached *seventy decibels*, that the nearest residence was over five hundred yards away, and that the sound level at appellees' residences was usually in the *forty-to-sixty decibel* range.

Relative noise is noise which is too loud relative to its time and location, like talking in a normal voice in a movie theater.”

It was claimed that the judgment of the trial court was so *overbroad* and all-encompassing as to be unconstitutional under Section 19, Article I, of the Ohio Constitution, and the Fifth and Fourteenth Amendments of the US Constitution. The decision of the higher court was that the trial court was too strict in closing the facility and remanded the case to the trial court with an order to place reasonable restrictions on the shooting activities at the property owned by the club.

**Unlike other shooting range cases, the higher court found that the range activities should be restricted, not stopped, most likely as to time-of-day and day-of-week. The use of “pure” and “relative” indicated that the court was unfamiliar with acoustical terminology, pointing out the importance in court cases to have a trained person make a clear presentation about the nature or sound and its effects on people. Provision 7.19 of Chapter 6 covers this subject. With the power of the National Rifle Association and Amendment II of the US Constitution, there has been an extensive discussion of non-punitive methods of addressing the noise problem**



#### 4.6.6 Shooting Range

##### *Brown v. Cedar Creek Rod and Gun Club*

The Missouri Supreme Court has upheld a \$700,000 judgment against the Cedar Creek Rod and Gun Club in a nuisance lawsuit that claimed the noise and vibration from shooting at the club diminished their quality of life. Five months later, an amendment to state law was enacted giving gun clubs immunity from lawsuits stemming from noise nuisances. The judge wrote that while the new statute protects the gun club from lawsuits over noise nuisances, it does not protect it from nuisance lawsuits based on *vibrations* caused by gunfire.

**The power of the National Rifle Association and other groups can be used successfully to defeat persons impacted by gunfire sound. Land use planning is the most successful method of preventing impact. See the Comments in Provision 7.19 of Chapter 6. The enforcement agency for the noise ordinance must work with the planning agencies to insure residences are not permitted to move close to an authorized shooting range (however difficult that can be). States exempting shooting ranges from litigation display no regard for the health and welfare goals of citizens in general and the shooter in specific.**

#### 4.6.7 Preaching in Public Spaces

##### *DeFerio v. Ithaca et al, New York Northern District Court, 2008*

Deferio alleged that while he was preaching on the Ithaca Commons, a police officer approached him and “explained that Deferio would have to lower his voice or stop speaking, because his voice could be heard 25 feet away,” in violation of the City’s noise ordinance.

The Ithaca, NY ordinance stated:

*“§184-5. Unreasonable noise prohibited. No person shall intentionally cause public inconvenience, annoyance, or alarm, or recklessly create a risk thereof, by making unreasonable noise or by causing unreasonable noise to be made.*  
*§184-7. Radios, television sets and other sound-producing or amplifying devices. (a) It shall be unlawful for any person within any Residential Zone, or within 500 feet of a Residential Zone, to use or to operate any radio or receiving set, musical instrument (including drums), phonograph, television set, any other machine or device for the producing or reproducing of sound or any other sound-amplifying equipment in a loud, annoying or offensive manner such that noise from the device interferes with the comfort, repose, health or safety of members of the public or recklessly creates a risk thereof, within any building or, outside of a building, at a distance of 25 feet or more from the source of such sound or interferes with the conversation of members of the public who are 25 feet or more from the source of such sound.”*

The officers’ reliance on a “25-foot rule” for restricting unamplified sound, which is not written in the City’s noise ordinance, was declared unconstitutional. In a similar and earlier case, the Second Circuit Court of Appeals upheld the constitutionality of Ithaca’s noise ordinance as written, but declared the application of the “25-foot rule” unconstitutional.

**This case suggests that a *plainly audible* provision must always have a reasonable distance at which it is applied. See Provision 7.1 of Chapter 6 for a distance that is considered defensible.**

#### **4.6.8 Motorcycle Noise**

##### *North Hampton v. Seacoast Harley-Davidson*

A suit was filed by motorcycle dealership, Seacoast Harley-Davidson, in opposition to a new North Hampton ordinance regulating decibel levels emitted by motorcycles. The North Hampton, NH noise ordinance (not verified) requires that motorcycle sound be limited to 80 dB(A) at 50 feet, similar to the federal law. It requires permanent stickers on post-1982 motorcycle exhausts indicating they meet federal environmental standards. The New Hampshire state law permits a stationary level measurement of 106 dB(A) at 20 inches which translates to about 76 dB(A) at 50 feet. About 20% of motorcycles tested exceeded the state limit.

One argument was that state law has pre-empted the North Hampton noise ordinance (Did they want the motorcycles to be quieter or did they not understand the law). Unfortunately, the New Hampshire law (RSA 31:39, Section I (n)) explicitly states:

*“Towns may make bylaws for regulating noise.”*

The following are comments made by various persons about the ordinance.

The Chief of Police stated: “The town ordinance is trying to circumvent state law and is not enforceable. It would be ridiculous for me to direct my men to enforce it”. The town attorney stated: “I feel that this petitioned ordinance is not legally enforceable because it exceeds the authority granted to municipalities under the controlling federal law”. Another person concluded that the state has jurisdiction over motorcycle noise, not individual communities. Another statement concluded that the state statute implies that towns can regulate noise made by anything *other* than motor vehicles. Another opinion stated: “that the ordinance was likely invalid in that it did not have a clear relation to promoting the public interest of lower noise levels or meet in an appreciable manner any relation to controlling noise and that the actual noise level of the vehicle is immaterial to whether or not a violation exists; a vehicle does not have to be emitting any sound at all to be in violation of the noise ordinance given that a vehicle that is merely parked may be in violation of the noise ordinance.” The local business association stated that enforcement would have a *chilling effect* on the three motorcycle dealerships they represented. It was also pointed out that stopping a motorcyclist for what could be a violation of the ordinance could be seen as a civil rights infraction and lead to lawsuits against the town and/or the officers involved. The ordinance targets only motorcycles.

**This case is an example of how much biased rhetoric is generated with the threat of economic loss, legal action, and implied violence that can intimidate city officials. It is clear that motorcycles can comply technically with the federal and city ordinances, despite comments to the contrary by city officials. See the Comments Section in Provision 10.1 of Chapter 6.**

## 4.6.9 Night Club

*Wichita v. Smith, Kansas Court of Appeals 2002*

The Wichita Police were called to complain about the excessive noise coming from a business establishment known as "Central Brews and Blues". Smith was issued a criminal complaint for allowing a loud noise by use of a loudspeaker or sound amplifier which was creating a nuisance or interfered with the use or enjoyment of property.

The Wichita city ordinance, 7.41.010(a) (2003) stated:

*"Loud and unnecessary noise prohibited.*

*(a) It is unlawful for any person to make, continue, or allow to be made or continued, any excessive, unnecessary, unusual or loud noise which creates a nuisance or injures or endangers the comfort, repose, health or safety of others, or which interferes with the use or enjoyment of property of any person of reasonable sensibilities residing in or occupying the area unless the making and continuing of such noise is necessary for the protection and preservation of property or the health and safety of some individual.*

*(b) The following acts, which enumeration shall not be deemed to be exclusive, are hereby declared to be noise nuisances in violation of this section and are unlawful:*

*(1) The playing or permitting or causing the playing of any radio, radio receiving set, television, phonograph, "boom box," loudspeaker, drum, juke box, nickelodeon, musical instrument, sound amplifier or similar device which produces, reproduces, or amplifies sound when done in such a manner or with such volume, intensity, or with continued duration so as to annoy, to distress, or to disturb the quiet, comfort, or repose of any person of reasonable sensibilities within the vicinity or hearing thereof. This subsection shall not apply to persons who have written authorization for an event which includes use of such a device, or to the police or public authorities who are using such a device in the performance of their duties.*

*Section 7.41.030 Excessive noise levels.*

*(a) A noise measured or registered as provided herein from any source not exempted by this chapter at a level which is equal to or in excess of the db(A) established for the time period and zones listed below or that exceeds the background level by five db(A), whichever is greater, is declared to be excessive, unusual, loud and unnecessary, for the purposes of Section 8.41.010:"*

The club had a cabaret license properly issued by the City. Smith pled no contest to the charge and was found guilty of violating the City's loud noise ordinance. Smith filed a notice of appeal to the Court of Appeals. Smith argued that he held a cabaret license which allowed the business to play live amplified music; therefore, he could not be found guilty of loud noise ordinance violation.

The license stated:

*"The person, firm or corporation named below is granted this business certificate pursuant to the provisions of the City Business License Ordinances to engage in, carry on or conduct the business, trade, calling, profession, exhibition or*

occupation described below. Issuance of the certificate is not an endorsement, nor certification of compliance with other ordinances or laws.”

The court decided:

“That the exception in (b)(1) which Smith claims is applicable refers to an authorization ‘for the event’ in which some sound producing device is utilized. This appears to refer to a single, special occurrence for which permission is needed. The cabaret license is issued for operation of an ongoing business and (b)(1) is not applicable here.

A noise ordinance which requires a city to prove the alleged excessive noise interferes with the use or enjoyment of property of any person of reasonable sensibilities residing in, or occupying, the area is not unconstitutionally vague.

The language of the ordinance in question, providing that noises exceeding certain decibel levels are declared to be excessive, does not require decibel measurements in all cases for there to be a finding of excessive noise.”

Smith also argued that the land use provisions (7.41.030) would be required to determine whether the noise in question was too loud. It was not used.

The court stated:

”...The ordinance states that “the following test measurements and requirements may be applied.” We read this language to mean much the same as the standards for determining whether a person is unlawfully driving under the influence of alcohol. Certain levels of alcohol in the blood, or noise in the city, are presumptively a violation of the law when measured in prescribed ways. There can be violations of ....the noise ordinance without the measurements, if the fact finder determines the prohibited conduct occurred. “

Smith also argued that the City's noise ordinance is *unconstitutionally vague*. The court used the *fair warning* principle and the guarding against *arbitrary and discriminatory enforcement* concept to disagree.

**Both subjective and objective provisions are recommended in this document. The provisions are worded so that the objective ones are not mandated in preference to the subjective. This simplifies enforcement when meters are not readily available. The other departments of a municipality must insure that any license or permit issued does not permit the licensee to ignore other ordinances unless specifically permitted in the license.**

#### **4.6.10 Unamplified Speech in Public Places**

*Luna, 28 Kan. App. 2d at 413-14.*

Luna was cited for excessive noise in a public place.

The City of Ulysses noise ordinance stated:

*“Section 1. Loud Noise Prohibited. It shall be unlawful for any person to make or cause or permit to be made upon any public or private property including public streets, alleys, thoroughfares or parks, any unnecessarily loud or excessive noise or sound which is physically or mentally annoying or disturbing to another*

*person or persons or which disturbs the peace, quiet, or comfort of another person or persons.”*

Luna argued the ordinance lacked an objective standard from which to determine what was “loud”, “excessive”, “mentally annoying”, and “disturbing”.

The Court of Appeals held:

“We conclude the loud noise ordinance of the City does not give *fair warning* to those potentially subject to its reach because there are no *objective* standards imparted. Loaded phrases and words in the ordinance 'unnecessarily loud,' 'excessive,' 'mentally annoying,' and 'disturbing' do not provide fair warning to an individual of prohibited conduct. The ordinance also provides that if the noise is disturbing to 'another person or persons, then the individual responsible for the noise is in violation, regardless if the complainants have reasonable grounds to complain. ...the absence of an objective standard subjects the defendant to the particular sensibilities of the complainant. The door is left open to *arbitrary and discriminatory enforcement* of noisy speech, thus, potentially ensnaring constitutionally protected speech.”

**Although some courts have accepted such somewhat vague expressions to describe too much noise, not all have. All the provisions in Chapter 6 have eliminated such expressions to reduce the possibility of the ordinance being struck down.**

## 4.7 Enforceability

Writing a *subjective* noise provision that fails to overcome the objections listed in this chapter makes it unenforceable as well as invalid. Writing an *objective* noise provision whose numbers are physically unrealizable can have the same result. For example, requiring the maximum sound level of an automobile to be 40 dB(A) or the maximum sound level in a residential zone to be 30 dB(A) opens the provision to an enforceability challenge. Reference to the recommended numbers in the various provisions of Chapter 6 and to Appendices A and B, provides numbers that are used in other ordinances and are highly likely to be enforceable.

However, most arguments about enforceability are social and political and are not addressed in this document.

## 4.8 Confiscation

Confiscation is the taking of private property for public use without compensation. It may occur legally when the government seizes property used in illegal practices. Confiscation may also be referred to as forfeiture. Confiscation may occur without an arrest of a person because it is seen as an arrest of property, rather than a person, and the necessity of finding a party guilty is not required in all cases. In many cases, the guilt or innocence of the property owner is irrelevant and the government need not prove anything “beyond a reasonable doubt.” In order to seize property, there must be either a warrant or a showing of probable cause. The mere showing of probable cause to support the forfeiture of an individual’s property has been a controversial issue. Court opinion varies, but probable cause most often means that the government need only

demonstrate reasonable grounds for the belief that the property is properly subject to forfeiture, which can be supported by something less than prima facie proof, but more than mere suspicion.

There are court cases that raise the issues associated with probable cause and the difference between confiscation, impoundment, and forfeiture. Some jurisdictions permit the confiscation of vehicles or their sound systems if in violation of the noise ordinance. Several examples are given below.

A proposed amendment to section 1(b) of section 24-257 of the administrative code of the city of New York in 2011, applicable to persistent violators of the noise ordinance, stated:

(11) order the confiscation of property or devices, used in willful and continual violation of any provision of this code or order or regulation promulgated by the commission or the board, which belongs to any person classified as a persistent violator as provided in paragraph ten of this subdivision. Such order shall be effective upon service thereof. Any party affected by such an order may request a hearing on written notice, and he or she shall be afforded a hearing, within twenty-four hours after service of such request, pursuant to section 24-263 of this subchapter. If such an accelerated hearing is not requested, then a hearing shall be afforded within ten days of the issuance of the order. The board shall issue its final decision and order thereon within three days from the conclusion of a hearing held pursuant to this subdivision.

Excerpts from an unspecified Florida community noise ordinance are:

**Sec. 50-492. Penalty; confiscation of noise-creating equipment; responsibility for violations.**

(a) Violations of this article are punishable as provided in section 1-7. Any person who continues to violate the provisions of this article after having been previously cited may be subject to further citations, including further citations issued on the day upon which the original citation was issued.

(b) Upon conviction of being in violation of this article three times for the same offense within a 12-month period, when such sound is created by the same sound emitter, the noise-creating equipment may be confiscated by the court following such latest conviction until such time as the offender can satisfy the court that he is prepared to and in fact will operate said equipment within the limits of this article. Further violation shall result in the permanent confiscation by the court upon such conviction.

(c) The owner of property, a tenant, a lessee, a manager, an overseer, an agent, corporation or any other person entitled to lawfully possess or who claims unlawful possession of such property at a particular time involved shall each be responsible for compliance with this article, and each may be punished for violation of this article. It shall not be lawful defense to assert that some other person caused such sound, but each lawful possessor or claimant of the premises shall be responsible for operating or maintaining such premises in compliance

with this article and shall be punishable, whether or not the person actually causing such sound is also punished.

(d) The environmental management service group under the direction of the environmental control officer shall be responsible for the enforcement and interpretation of this article.

**Sec. 15-6. Violation procedures.**

(a) *Violation of sound level limits; violation of plainly audible standard on other than posted property.*

(2) *Citation; confiscation of sound emitter.*

a. If the sound is not eliminated or is not reduced to allowable limits within a reasonable time after the warning, or if the noise or sound is abated after warning and then reoccurs, the person so warned and not complying shall be cited for a violation of this chapter.

b. The city manager or designee shall notify the operator of any device that produces sound in excess of the limits set by Table I or Table I-A in section 15-3(b) that the device is a health hazard. The city manager or designee shall have the power and authority to have the device removed or toned down instantly until such time as it can be otherwise operated in compliance with this chapter.

Excerpts from the Peoria, Illinois noise ordinance are:

**Sec. 15-75. –Radios, Phonographs, etc. on the Public Way.**

No person shall play, use, operate or permit to be played, used or operated any radio, tape recorder, cassette player, device for receiving broadcast sound or reproducing recorded sound, or any other sound amplification system if the device is located:

(1) On the public way; or

(2) In any motor vehicle on the public way;  
and the sound can be heard from 75 feet or more.

**Sec. 15-77. - Vehicle seizure and impoundment.**

(a) A motor vehicle, operated with the permission, express or implied, of the owner of record, that is used in violation of section 15-75 of this code shall be subject to seizure and impoundment under this section. A motor vehicle used in violation of section 15-75 of this Code shall be declared a public nuisance. The owner of record of such vehicle shall be liable for the towing and storage of the vehicle. For a second offense within a two-year period involving the same vehicle, the owner of record of such vehicle shall be liable to the city for a penalty of \$250.00 in addition to fees for the towing and storage of the vehicle; for a third or subsequent offense within a two-year period, the owner of record of such vehicle shall be liable to the city for a penalty of \$500.00 in addition to fees for the towing and storage of the vehicle.

(b) Whenever a police officer has probable cause to believe that a vehicle is subject to seizure and impoundment pursuant to this section, the police officer shall provide for the towing of the vehicle to a facility controlled by the city or a tow company from the rotation tow list set forth in Chapter 30 of this Code. When the vehicle is towed, the police officer shall notify the person who is found to be

in control of the vehicle at the time of the alleged violation, if there is such a person, of the fact of the seizure and of the vehicle owner's right to request a preliminary hearing to be conducted under this section. Said vehicle shall be impounded pending the completion of hearings provided for in subsections (c) and (d) herein, unless the owner of the vehicle pays for the towing and storage of the vehicle. For a second offense, said vehicle shall be impounded pending the completion of hearings provided for in subsections (c) and (d) herein, unless the owner of the vehicle posts with the city a cash bond in the amount of \$250.00, or, for a third or subsequent offense within a two-year period, \$500.00, plus fees for the towing and storage of the vehicle.

(c) Whenever the owner of a vehicle seized pursuant to this section requests a preliminary hearing within 24 hours after the seizure, a hearing officer of the city shall conduct such preliminary hearing within 72 hours after said seizure. All interested persons shall be given a reasonable opportunity to be heard at the preliminary hearing. The formal rules of evidence will not apply at the hearing and hearsay evidence shall be admissible. If, after the hearing, the hearing officer determines that there is probable cause to believe that the vehicle, operated with the permission, express or implied, of the owner, was used in the commission of any crime set forth in this section, the hearing officer shall order the continued impoundment of the vehicle as provided in this section unless the owner of the vehicle posts with the city a cash bond in the amount of \$250.00, or, for a third or subsequent offense within a two-year period, \$500.00, plus fees for the towing and storage of the vehicle. If the hearing officer determines that there is no such probable cause, the vehicle will be returned without penalty or other fees.

(d) Within ten days after a vehicle is seized and impounded pursuant to this section, the city shall notify by certified mail, return receipt requested, the owner of record at his/her last known address as indicated by the vehicle's registration of his/her right to request a hearing before the hearing officer that will be conducted to determine whether the subject vehicle is eligible for impoundment pursuant to this section. However, no such notice need be sent to the owner of record if the owner is personally served with the notice within ten days after the vehicle is impounded, and the owner acknowledges receipt of the notice in writing. The notice shall state the penalties that may be imposed if no hearing is requested, including that a vehicle not released by payment of the penalty and fees and remaining towing/storage facility may be sold or disposed of by the city or the tow operator in accordance with applicable law. The owner of record seeking a hearing must file a written request for a hearing with the city legal department no later than 15 days after the notice was mailed or otherwise given under this subsection. The hearing shall be scheduled and held unless continued by order of the hearing officer, no later than 45 days after the request for a hearing has been filed. All interested persons shall be given a reasonable opportunity to be heard at the hearing. The formal rules of evidence will not apply at the hearing, and hearsay evidence shall be admissible. If, after the hearing, the hearing officer determines by a preponderance of evidence that the vehicle was used in the commission of a violation of section 15-75, the hearing officer shall enter an order requiring the vehicle to continue to be impounded until the owner pays towing



and storage of the vehicle, or for a second offense, a penalty of \$250.00, or, for a third or subsequent offense within a two-year period, \$500.00, plus fees for towing and storage of the vehicle. The penalty and fees shall be a debt due and owing the city. However, if a cash bond has been posted, the bond shall be applied to the penalty. If the hearing officer determines that the vehicle was not used in commission of such a violation, he/she shall order the return of the vehicle or cash bond and the city shall be liable for towing and storage fees.

The Colorado Springs, CO code states:

F.3.a. The sound amplification system shall be confiscated by a police officer, when, on service of a citation for a violation of section 9.8.102 of this part the arresting officer has knowledge or information that the person suspected of violating this section has two (2) previous convictions for violating this section.

# Chapter 5

## General Provisions of a Community Noise Ordinance

*This chapter contains the more general provisions of a community noise ordinance, and its definitions while Chapter 6 contains provisions specific to particular noise sources.*

### Introduction

Each article is set out with a recommended format and in some, several alternative formats. The notations are as follows:

- **Alternative** Several alternative wordings may be shown.
- **(N)** A number should be entered at this point.
- **(Agy)** The name of the responsible agency should be entered.
- **[xx]** The wording between the brackets is optional.
- **Definitions Needed** A list of definition numbers needed for a provision.
- **Comments** The text explains the meaning of the provision, how it relates to other provisions, and provides supportive data.
- **Existing Provisions** Examples of existing ordinances are given.
- **Recommended Values** A discussion of reasons for recommendations being made.
- **{xx} Website Abbreviations**
  - {NFA} = Noisefree.org (Noise Free America)
  - {NOff} = Noiseoff.org (Noise Off)
  - {NPC} = Nonoise.org (Noise Pollution Clearinghouse)
  - {BD} = Barkingdogs.net

### Article I SHORT TITLE

This ordinance may be cited as the Noise Control Ordinance of the City of \_\_\_\_\_.

### Article II DECLARATION OF FINDINGS AND POLICY

WHEREAS excessive sound and vibration are a serious hazard to the public health and welfare, safety and the quality of life, and WHEREAS a substantial body of science and technology exists by which excessive sound and vibration may be substantially abated; and, WHEREAS the people have a right to, and should be ensured, an environment free of excessive sound and vibration that may jeopardize their health and welfare or safety or degrade the quality of life; and NOW THEREFORE, it is the policy of \_\_\_\_\_ to prevent excessive sound and vibration which may jeopardize the health and welfare or safety of its citizens or the quality of life.

This ordinance shall apply to the control of all sound and vibration originating within the limits of \_\_\_\_\_.

## Comments

Many communities have used the word “unnecessary” in addition to “excessive”. The word “unnecessary” implies that a listener is capable of deciding that a noise source is, or is not, necessary, as opposed to the sound being disturbing. The word “excessive sound” is more objective since it can be related to sound levels that in turn can be tied to health and welfare effects. The definition of “noise” is included but is not used in this document as a descriptor of sound. The scientific definition is “unwanted sound” which implies that the sound is already unwanted and prosecutable. The word “sound” is used extensively in this document to tie it to a physical phenomenon that can be measured. The conversion to “noise” occurs when a violation is upheld. Vibration has been added since it can result in degradation of the environment.

## Article III DEFINITIONS

### Terminology and Recommended Definitions

All terminology used in this ordinance, not defined below, shall be in conformance with applicable standards of the American National Standards Institute (ANSI) or its successor bodies. The definitions listed immediately below provide the general technical basis for an ordinance and should be incorporated in *any* ordinance.

Sections 3.11, 3.27, 3.43, 3.46, 3.48, 3.49, 3.50, 3.51, 3.52

## Comments

The American National Standards Institute is represented by experienced acousticians from all professional affiliations and does not represent any industry group. The standards are written to be scientifically correct and are not always readily adaptable to noise ordinances. As a result, the definitions in this article take precedence over ANSI standards where they differ.

Communities with racing events such as motorcross or vehicle acceleration competitions, have included definitions that specify the particular type of vehicle and the venue for them. Definitions of this type are **not** included in this article.

Not all of the definitions listed below are incorporated in the provisions of Chapter 6. A number are abstracted from well written ordinances that use different types of provisions.

### 3.1 A-Weighted Sound Level ( $L_a$ , dB(A), dBA) means

*The sound pressure level in decibels as measured on a sound level meter using the A-weighting network as specified in ANSI documents for sound level meters. The level so read is postscripted dB(A) or dBA.*

## Comments

The A-weighting network is preferred for adjusting the actual sound spectrum to one more nearly like that heard by a person. The weighting network is the result of much research, is commonly used by communities, and is the preferred weighting network for an ordinance.

### 3.2 Airboat means

*Any vessel that is powered by an internal combustion engine with either an airplane-type propeller mounted above the stern, used to push air across a set of rudders, or vertically mounted propellers that provide levitation in the cushion below the vehicle.*

#### Comments

Airboats differ from normal motorboats in that in addition to an internal combustion engine, they have large propellers to drive the vehicle. The sound levels are similar to those from actual aircraft but the vehicle is capable of being much closer to residential areas. Florida is a state with noise impact from many airboats.

### 3.3 Ambient (Background) Sound Level means

*(a) The sound level of the all encompassing sound associated with a given environment, being usually a composite of sound from many sources and excluding the specific sound under investigation.*

*(b) The A-weighted sound pressure level exceeded 90 percent of the time for (N) minutes ( $L_{90}$ ).*

#### Comments

A non-technical definition: If a listener outside is unable to point at the source of sound, it is likely to be “ambient”; the sound field is diffuse (coming from many directions). This is essentially the first definition and is very useful since noise complainants are most often able to point at the source. The second definition is statistical; it defines ambient as the lowest level that occurs over a given period of time. Although  $L_{90}$  is a good technical measure, it does not take into account the source of the sound (a dominant but highly variable level source will create the  $L_{90}$ ). It also requires costs in time and equipment to measure correctly. Many ordinances include a variety of other definitions of ambient sound level. Unfortunately, it is virtually impossible to define the ambient sound level in such a way that it applies to all possible enforcement situations. If the ordinance includes ambient, a supplemental, or specific definition, might need to be included in the applicable provision. The value of **N** is recommended to be 60 (one hour) in order get enough data for a defensible level. San Francisco, CA puts a lower limit on what can be considered ambient; an actual ambient below that level is set to the fixed lower limit. Some communities use “background level” as a descriptor.

### 3.4 C-Weighted Sound Level ( $L_c$ , dB(C), dBC) means

*The sound pressure level in decibels as measured on a sound level meter using the C-weighting network as specified in ANSI documents for sound level meters. The level so read is postscripted dB(C) or dBC.*

### **Comments**

The A-weighting network is preferred for adjusting the actual sound spectrum to one more nearly like that heard by a person. This weighting network is used in some ordinances to capture more low frequency sound. An ordinance can contain both A and C network maximum levels as both are available in ordinary sound level meters.

## **3.5 Common Carrier means**

*Any person that transports goods or people for any person and offers its services to the general public under license or authority provided by a regulatory body.*

### **Comments**

In the context of a noise ordinance, this definition is applied to buses in which excessively loud sound sources are used.

## **3.6 Commercial/Industrial Use Zone means**

*(must be defined locally)*

### **Comments**

Colorado Springs, CO defines a commercial zone as:

- An area where offices, clinics and the facilities needed to serve them are located;
- An area with local shopping and service establishments located within walking distances of the residents served;
- A tourist-oriented area where hotels, motels and gasoline stations are located;
- A large integrated regional shopping center;
- A business strip along a main street containing offices, retail businesses and commercial enterprises;
- A central business district; or
- A commercially dominated area with multiple-unit dwellings.

Since much enforcement is intended to protect citizens at their residences, so some communities (e.g., Houston, TX) also define a “non-residential zone” to simplify enforcement.

## **3.7 Construction means**

*Any site preparation, assembly, erection, substantial repair, alteration, or similar action, but excluding demolition, for, or of, public or private rights-of-way, structures, utilities, or similar property.*

## **3.8 Continuous Sound means**

*Any sound which does not vary in sound level more than ( $N_1$ ) dB(A) during a measurement period which shall be at least ( $N_2$ ) minutes.*

### **Comments**

People may accept interfering sounds that exist for reasonable periods of time, but do not accept those that persist for extended time periods. It is recommended that the value of  $N_1$  be 5 dB to separate it from sounds that vary strongly during a period. The recommended value of  $N_2$  is 60 minutes. Many ordinances and measurement regulations require one hour to establish a noise impact.

## **3.9 Cyclically Varying Sound means**

*Any sound which varies in sound level more than ( $N_1$ ) DB(A) during a measurement period such that the same level is obtained repetitively at reasonably uniform intervals of time less than ( $N_2$ ) minutes.*

### **Comments**

This definition is intended for sound sources that cycle in time, such as air conditioners. It is not related to pure tone; the sound spectrum can be random also. Intermittent sounds that recover the same level when operating have been found to be annoying to listeners. Continuous random sounds do not create the same negative impact. To separate this sound from continuous sound the level change  $N_1$  is recommended to be 5 dB(A). The cycling of air conditioner units is one example. The recommended value of  $N_2$  is ten minutes.

## **3.10 Day-Night Average Sound Level ( $L_{dn}$ , DNL) means**

*The twenty-four hour average of the hourly A-weighted energy averaged sound levels at a particular location when the level is weighted as follows: From 7 am to 10 pm there is no level adjustment. From 10 pm to 7 am, 10 dB is added to the actual level.*

### **Comments**

This descriptor helps to define the noise environment at a location. It says nothing about specific noise sources or when noise is worst (unless the hourly data are supplied). It is useful to estimate the impact on citizen's health and welfare, but is not particularly useful in enforcement. It requires a meter that has the capability to measure and average sound over at least a 24 hour period. See Appendix C.11.1 for more details.

## **3.11 Decibel (dB) means**

*A logarithmic (dimensionless) measure used in describing the amplitude of sound.*

### **Comments**

This is a generic expression for a measurement and is used for many purposes other than sound, so it is not tied specifically to sound. It is as improper to say "decibel level" than it is to say "voltage volts". The above description is general only and does not take precedence over the more precise definition of "sound pressure level."

### 3.12 Demolition means

*Any dismantling, intentional destruction of, or removal of, structures, utilities, public or private right-of-way surfaces, or similar property.*

#### Comments

Demolition differs from construction in several ways. It more often includes blasting and high sound levels and may occur over a shorter time period. As a result, variance for such work needs to be different than those for construction.

### 3.13 Engine Braking Device means

*A compression braking device installed on large motor vehicles to assist in reduction, or control, of vehicle speed. When activated, the engine converts from a power source to a power absorber by converting the engine into an air compressor.*

#### Comments

These devices are erroneously called Jacobs, or Jake, brakes, referring to the company that manufactures the most commonly used device. As an air compressor, large pulses of air are emitted, resulting in high sound levels, if not properly muffled.

### 3.14 Emergency means

*Any occurrence or set of circumstances involving actual or imminent physical trauma or property damage which demands immediate attention.*

### 3.15 Emergency Work means

*Any work performed for the purpose of preventing or alleviating the physical trauma of persons or property damage threatened or caused by an emergency.*

#### Comments

The above definition is broad and includes such services as repair of water, gas, electricity, telephone, sewer, roadways, landslides, floods, public transportation facilities, removing trees on public rights-of-way, or other life-threatening conditions or actions as the result of declaration of a state of emergency.

### 3.16 Equivalent A-Weighted Sound Level ( $L_{eq}$ ) means

*The constant sound level that has the same energy as the actual time-varying A-weighted sound level over a specific period of time of (N) (minutes, hours).*

#### Comments

Sound meters record and display the actual sound level over short periods of time, i.e., less than a second. In almost all cases the display changes continually making it difficult to determine a specific number. This metric sums the sound energy over an assigned period to yield a number that is indicative of the actual noise impact. See Appendix C.2.5 for more

details. Depending on the application, the period (N) can be minutes or hours. Simple sound meters do not have the capability of performing such a measurement.

### **3.17 Gross Vehicle Weight Rating (GVWR) means**

*The value specified by the manufacturer as the recommended maximum loaded weight of a single motor vehicle. In cases where trailers and tractors are separable, the gross combination weight rating which is the value specified by the manufacturer as the recommended maximum loaded weight of the combination vehicle.*

### **3.18 Impulsive Sound means**

*Any sound or vibration of short duration that has an abrupt increase and abrupt decay.*

#### **Comments**

Impulsive sources put much energy into short duration events. Typically, they result in high sound or vibration levels which initiate the startle response in persons and thus can have a strong impact on a person's health and welfare. A weapon discharge at a gunnery range is an example. The difficulty for enforcement is that simple sound level meters cannot accurately measure one such event; only meters with peak detectors can. See Appendix E.5. An approximate measurement can be made if the event is repetitive (e.g., several times a second).

Most ordinance definitions include the expression "of duration less than one second" as opposed to "short". Although scientifically correct, it opens the door to requiring the NCO to establish the fact that the duration was less than one second, including rise and decay times. The present definition permits an NCO some discretion, such as for a person beating a large drum. If needed, and a meter capable of measuring peak levels is available, the NCO can always establish the one second criterion.

### **3.19 Intermittent Sound means**

*Any source that ceases to emit sound at intervals. The levels during on periods may be either constant or varying.*

#### **Comments**

Large sound level changes that occur periodically are more annoying than constant level sounds. The definition is in distinction to cyclically varying sound since the intervals may not be regular. Power saws operating at residences are examples. The average noise impact is diminished due to the off periods.

### **3.20 Low Frequency Sound means**

*Any source of sound in which the bass is measurably higher than the treble; the C-weighted sound level is more than 8 dB higher than the A-Weighted sound level.*



## **Comments**

A number of music systems are capable of producing high levels of low frequency sound, the so-called “boom box”. The sound is characterized by a plainly audible beat. Both home and automobile systems can have this capability.

### **3.21 Motor Carrier Vehicle Engaged in Interstate Commerce means**

*Any vehicle for which regulations apply pursuant to the federal Noise Control Act of 1972, as amended, pertaining to motor carriers engaged in interstate commerce.*

### **3.22 Motorboat means**

*A motor powered vehicle capable of being used on water during the period the motor is in use and is driven by an underwater propeller.*

## **Comments**

Motorboats include fishing and speed boats, cabin cruisers, powered sail boats. They may have either inboard or outboard engines. These vehicles are distinct those driven by aerodynamic propellers, such as airboats and hovercraft, so the term “watercraft” is not recommended.

### **3.23 Motorcycle means**

#### **Alternative 1**

*A motor vehicle, with or without a side car, designed to travel with no more than three wheels in contact with the ground, including every motor scooter, motor-driven cycle, and moped, whose power exceeds six brake horsepower, excluding farm tractors.*

#### **Alternative 2**

*Any vehicle defined as such in the motor vehicle code of the State of \_\_\_\_\_.*

## **Comments**

There are a large number of small powered vehicles that are excluded as motorcycles, such a motor scooters and powered bicycles. Using a power criterion permits them to be excluded. A motorcycle is a motor vehicle as defined below and using a separate definition has both positive and negative aspects. Motorcycles are constructed differently from automobiles and so warrant separate consideration with regard to noise. When motorcycle owners are cited, their separation from automobiles can be, and often is, declared discriminatory.

### **3.24 Motor Vehicle means**

#### **Alternative 1**

*Any vehicle that is propelled or drawn on land by a motor, whether tracked or wheeled, such as, but not limited to, passenger cars, trucks, truck-trailers, semi-trailers, campers, go-carts, snowmobiles, amphibious craft on land, dune buggies, or racing vehicles [but not including motorcycles].*

### ***Alternative 2***

*Any vehicle defined as such in the motor vehicle code of the State of \_\_\_\_\_.*

#### **Comments**

There are an enormous number of vehicle types, all of which create different sound spectrum shapes and overall levels. If such aspects are important for an ordinance, it is recommended that the California state statutes be viewed. They have a detailed listing of the various types.

### **3.25 Muffler means**

#### ***Alternative 1***

*Any device for the abatement of sound emission while permitting the transfer of gas. A muffler is considered to be in good working order if the sound reduction is equal to, or greater than, that of the original equipment.*

#### ***Alternative 2***

*Any device for the abatement of sound emission while permitting the transfer of gas. To qualify, such device must cause a reduction of at least N dB upon insertion into the system for which it was intended.*

#### **Comments**

Many ordinances describe the purpose of the muffler instead of specifying its performance. Alternative 1 requires the performance to be equivalent to the original equipment. It is based on the existence of federal and state maximum sound level limits for the sale of new products. Alternative 2 may be used to specify performance of all mufflers. It does exclude megaphone mufflers or straight pipes called “mufflers”, but is **not** recommended. The reduction amount must vary with the type of source; the louder ones require more attenuation. If specifying a reduction is desired, it should be placed directly in the appropriate provision (e.g. racing events).

### **3.26 Ninetieth Percentile Sound Level (L<sub>90</sub>) means**

*The A-weighted sound level that is exceeded ninety percent of the time during a measurement period.*

#### **Comments**

Environmental sound typically varies based on the activity near the location. This metric describes the lower continuous levels experienced during the measurement period; it is the *chronic noise exposure* at the location. Depending on its intended use, the measurement period can be as short as ten minutes and as long as a sequence of one hour periods over twenty four hours. Simple sound level meters are incapable of making these measurements. See Appendix C.2.6. It has one weakness for noise ordinance enforcement. It does not separate the sound from a potential offender from that caused by the ambient.

### 3.27 Noise means

*Any unwanted sound.*

#### Comments

Among acousticians noise is defined as unwanted sound. The above definition is more useful for a noise ordinance, if it is needed at all. It is entirely subjective and requires the cooperation of persons, generally manifested in the form of complaints. It must be established that the complaint is based *solely* on sound and not on the *anticipation* of disturbance. The weakness of the definition is that it only establishes that a person does not want the sound and not that it is violation of an ordinance provision. It is recommended that Definition 3.29 be used in place of this definition. That definition is used in a number of noise ordinances.

### 3.28 Noise Control Officer (NCO) means

*Any officially designated employees of the municipality that have primary responsibility for noise control and have received training in the standards for the measurement of sound levels and is empowered to issue a summons for noise related violations.*

#### Comments

Many communities are not large enough or do not have sufficient noise problems to warrant the employment of a specialist specifically trained in acoustics and noise ordinance enforcement, but some degree of training is strongly recommended to ensure that ordinance enforcement is defensible.. In many cases, the responsibility is divided among several departments such as police, animal control officers, or building officials.

### 3.29 Noise Disturbance means

*Any sound or vibration which:*

- (1) may disturb or annoy reasonable persons of normal sensitivities or;*
- (2) causes, or tends to cause, an adverse effect on the public health and welfare or;*
- (3) endangers or injures people or;*
- (4) endangers or injures personal or real property.*

#### Comments

This definition goes beyond the “unwanted” aspect of noise. The first part is the most utilized definition for noise ordinance enforcement and better describes “unwanted”. The second part allows the use of Chapter 3 materials to establish the negative effects of sound and permits establishment of numerical sound level limits. The third and fourth parts refer to situations where physical, or financial, injury to persons or property can result from excessive sound. For example, the loss of home values in noise impacted areas.

### 3.30 Noise Sensitive Zone means

*Any area designated to be exceptionally sensitive to noise disturbance. The following areas are considered to be noise sensitive: [attach list]*

#### Comments

There are geographic areas where even normal activity sounds may have negative impact on the persons in that area, requiring exceptional care in providing quiet. There are a number of difficulties in creating such a list. Indiscriminant choice of many facilities to be included can create a difficulty for the NCO, resulting in lack of enforcement. Geographically defining the zone can be exceedingly difficult. The noise disturbance definition for each noise sensitive facility may be different (Patient recovery in hospitals vs. disruption of school activities). The *fair warning* issue may require an adequate number of signs designating each zone. Facilities included in typical lists, such as churches, are widespread throughout a community creating a matrix of quiet zones making compliance or enforcement difficult. Further, it appears that the origin of these zones was due to open windows in these facilities which is no longer a relevant issue. Another problem is whether the regulation should be an *immission* control or an *emission* control. Limiting the sound heard may be difficult as it may be the composite of the ambient, sirens, and a multiplicity of vehicles. An emission control would require control of all sources nearby to each of the noise sensitive facilities. For example, in southern states, air conditioners in residential areas will be near local churches. That is best handled by proper land use planning. There is little control when the facilities are under the flight paths of aircraft, obviating the value of having a noise sensitive designation.

Consider some of the candidates to be added to the list.

Most modern hospitals are built so sound attenuating that traffic noise cannot be heard in patient rooms; only helicopter operations can be heard. Internal sound sources, such as announcements, patient cries, television sounds, and machine sounds, far outweigh external sounds. As a result, hospitals are poor candidates for inclusion. Control of hospital sound is more the subject of hospital design.

Most modern churches, due to tax exemptions, have considerable surrounding land, especially in suburban areas, reducing potential noise impact. They are generally built to be reasonably sound attenuating and the time for freedom from distraction is typically limited to Sundays during service hours. Further, just prior to those hours, church bells and chimes may sound in the surrounding community. Adding specific hours of quiet to specific facilities would be impractical.

Schools have two times: in the outside playground during break and while classes are in session. Playground activity can only be a problem when teacher's calls cannot be heard. The buildings almost all have windows, so disruption of class activity can occur. Like modern hospitals, internally generated sound often exceeds exterior sound. If a school is to provide a quiet internal environment, interior loudspeakers need to be controlled, particularly in reverberant gymnasium events. External sound generated within school property can be a problem. In a local high school, the most disruption occurs by honking and loud vehicle sound systems owned by the students themselves. In open plan schools, the student sounds are the major problem. Inclusion of schools should be considered carefully.

Courts have traditionally been included in many ordinances. The stress associated with court cases suggests that noise sensitivity is high for participants. Depending on the structure and location of the court houses, inclusion is a possibility.

Modern libraries are built reasonably sound attenuating, minimizing *external* noise impact on patrons. Libraries are areas where *internal* quiet has always been maintained by librarians. Patron concentration is an important ingredient of understanding written material so noise sensitivity is an issue. In most libraries used by the author, the major noise problem was internally generated conversational sound. It has been solved with sound masking which reduces the impact of both external and internal sound sources. Older libraries that would have open windows near local streets are good candidates for the list.

Child care facilities have been included in some ordinances. The children make considerable sound during the periods of activity and go into deep sleep during nap time. The addition of such facilities should be considered but each facility should be examined carefully.

Retirement homes have been included in some ordinances. Many occupants have hearing losses so noise impact is diminished. Sleep deprivation is the major issue at these facilities, as older persons do not sleep as well. The addition of such facilities should be considered but each facility should be examined carefully.

Albuquerque, NM includes “dwelling units” as noise sensitive. Article IX is designed to handle this situation and inclusion is **not** recommended. Indianapolis, IN has an extensive list of areas considered to be noise sensitive (Sec. 441-111). Richmond, CA lists single and multi-family residences, mobile homes, motels and hotels, dormitories, hospitals, convalescent care and rest/nursing facilities, any use containing sleeping quarters, places of worship, libraries, and educational facilities.

The purpose of a noise ordinance is to free citizens from excessive noise impact. As noted above, there are very few situations where extraordinary control is required to warrant designating an area as noise sensitive. If the provisions of Articles IX and X are properly written, the potential difficulties (noted above) of specifically enforcing a noise sensitive zone can be eliminated. In summary, it appears that the main value of designating noise sensitive zones is to give selective enforcement directions to the NCO.

### 3.31 Octave Band Sound Pressure Level means

*The sound pressure level detected in any band of frequencies one octave wide.*

### 3.32 Off-road Vehicle means

*Any motorized track or wheeled vehicle designed, or used, for ground travel over private or public natural terrain.*

#### **Comments**

Such vehicles include motorcycles, all-terrain vehicles, and four-wheeled drive vehicles. Snowmobiles are similar but are treated separately in most ordinances. They are generally for recreational use and are powered by internal combustion engines. No power limitation is included as there are small motorcycles that can be used in such a way as to generate significant sound. Note that street legal vehicles are also included.

### 3.33 Peak Sound Pressure Level ( $L_{pk}$ ) means

*The maximum sound level determined by use of a sound level meter with a peak detector.*

#### **Comments**

The proper measurement of impulsive sound requires a meter that can measure very short term sound levels. See Appendix E.5 for more details. Most normal meters do not have the capability to measure impulse sounds correctly, but use of the slower responses such as FAST results in lower levels. The maximum hold feature of a meter is a desirable characteristic for this case. See Appendix E.9.

### 3.34 Person means

*Any individual, association, partnership, joint venture, or corporation, and includes any officer, employee, department, agency, or instrumentality of a state or any political subdivision of the state.*

### 3.35 Place of Public Entertainment means

*Any location, exterior, or interior, to a building that regularly permits public entrance for entertainment purposes. For this purpose, “public” means citizens of all types, including but not limited to, children, and private or public employees.*

### 3.36 Plainly Audible Sound means

*Any sound for which the information content is unambiguously communicated to the listener, such as, but not limited to, understandable speech, comprehension of whether a voice is raised or normal, repetitive bass sounds, or comprehension of musical rhythms, without the aid of any listening device.*

#### **Comments**

“Clearly audible sound” is an alternative wording. This definition is intended to fill the gap between the subjective listener response of annoyance and the objective measure of sound levels. It provides the NCO and the citizen with a criterion for evaluating how unreasonable a sound might be, and provides an enforcement officer a means for confirming a violation without sound level meter measurements. This definition is often applied to loud music, parties, and exterior loudspeakers. Use of this definition permits a recording to be made of the sound and then to be brought to court for others to evaluate. It provides an alternative to the older provisions of “ambient plus X dB” when applied to meaningful sounds. There are several other sounds that fit into the “information content is unambiguously communicated” category. Clock chimes, and model airplane sounds are examples.

### 3.37 Power Tool means

*Any device powered mechanically, by electricity, by gasoline, by diesel fuel or by any other fuel, which is intended to be used, or is actually used for, but shall not be limited to, the performance*

*of such functions as cutting, nailing, stapling, sawing, vacuuming or drilling.*

### **3.38 Powered Model Vehicle means**

*Any self-propelled airborne, water-borne, or land-borne, plane, vessel, or vehicle, which is not designed to carry persons, including, but not limited to, any model airplane, boat, car, or rocket.*

#### **Comments**

The development of the model industry has resulted in more powerful propulsion means and higher sound levels. Noise intrusions are typically from parks or open fields adjacent to residential areas. The vehicle is typically smaller than those intended for passengers. Note that although the definition uses the word “model”, it does not include size restrictions. See Definition 3. 44.

### **3.39 Public-Right-of -Way means**

*Any street, avenue, boulevard, highway, sidewalk, alley, or similar place which is owned or controlled by a governmental entity.*

### **3.40 Public Property means**

*Any real property, or structures thereon, which are owned or controlled by a government entity.*

### **3.41 Pure Tone means**

*(a) Any sound that can be heard as a single pitch or combination of pitches, or;*

*(b) any sound in which the one-third octave band sound pressure level in the band with the tone exceeds the level in the two contiguous one-third octave bands by 5 dB in bands 500 Hz and above, by 8 dB for bands between 160 and 400 Hz, and by 15 dB for bands below 160 Hz.*

#### **Comments**

Pure tones are always more annoying than broadband random sound with the same energy, so it is necessary to have a definition that separates the two types. The scientific definition of a pure tone is a sound at a single frequency (pitch). Most musical instruments and many machines create a “pure tone” as well as harmonics of that tone at higher frequencies. The first part of the definition includes that extension and permits an NCO to subjectively evaluate the presence of a tone. The second part of the definition allows the NCO to measure the magnitude of the tone relative to adjacent bands; simple sound level meters are not capable of doing this. Since most noise ordinances reduce the maximum permitted levels when a pure tone exists, this latter alternative should be used to defensibly establish the presence of a tone for sources where abatement could be very expensive. Connecticut defines provision (b) in a more detailed way (Sec. 22a-69-1.2).



### 3.42 Real Property Boundary means

*An imaginary line along the ground surface, and its vertical extension, which separates the real property owned by one person from that owned by another person, but not including intra-building real property divisions.*

#### Comments

Sound measurements are often made at, or near to, real property boundaries. The vertical extension is to handle rooftop air conditioners and listeners in apartment buildings. The use of “another person” allows inclusion of public property and easements. Sound propagating across interior surfaces of buildings is excluded. San Francisco uses “property plane” to denote the vertical extension.

### 3.43 Real Time Analyzer (RTA) means

*An instrument that meets the definition of a sound level meter, but includes more functions.*

#### Comments

There are several beneficial functions in a *real time analyzer*; the choice of function depends on the specific ordinance components chosen. One function is the ability to record, store and recover a sound level history. Another function is to record, store, and recover the actual levels of sound at short intervals of time to create a table that shows the number of times a particular sound level was reached during the measurement period. Another function is to divide the sound spectrum at any time into its frequency components and display, or store, a spectrum of the frequency distribution. This latter function is often called an octave, or one-third octave, band filter. See Definition 3.31 and Appendix C.2.4.

### 3.44 Remote Controlled Vehicle means

*Any airborne, water-borne, or land-borne, plane, vessel, or vehicle, which is controlled remotely but carries no passengers.*

#### Comments

This definition, although overlapping 3.38, extends coverage to full size vehicles that may be used to carry passengers, but are capable of being operated without them. The sound impact of large vehicles is different than that of model vehicles.

### 3.45 Residential Use Zone means

*(must be defined locally)*

#### Comments

Colorado Springs defines it as an area of single or multi-family dwellings where businesses may or may not be conducted in the dwellings. The zone includes areas where



multiple-unit dwellings, high-rise apartment districts, and redevelopment districts are located. A residential zone may include areas containing accommodations for transients such as motels and hotels and residential areas with limited office development, but it may not include retail shopping facilities. Residential zone includes educational facilities, hospitals, nursing homes and similar institutions.

### **3.46 RMS Sound Pressure ( $P_{\text{rms}}$ ) means**

*The square root of the time averaged square of the sound pressure.*

#### **Comments**

RMS means root-mean-square. To get a number the sound signal is squared to get rid of the negative phase, then is averaged and the square root taken. The averaging time depends on the specific application. This definition is required to support the definition of sound pressure level. See Appendix C.2.1.

### **3.47 Shooting Range means**

*A specialized licensed facility designed for firearms practice.*

#### **Comments**

Shooting ranges can be indoor or outdoor and possibly restricted to certain types of small firearms such as handguns or rifles, or they can specialize in certain sports such as skeet shooting. Because of the high impulse sound of firearms, outdoor facilities need large acreage or a large distance from residential zones.

### **3.48 Sound means**

*A temporal and spatial oscillation in pressure, or other physical quantity, in a medium resulting in compression and rarefaction of that medium, and which propagates at finite speed to distant locations.*

#### **Comments**

The definition includes both sound in air and vibration in materials. It excludes pressure oscillations that are not sound or vibration (Appendix C). An example of exclusion is the “sound” heard when a high wind passes over the ear; such “sound” does not propagate to distant locations and is not part of a noise ordinance.

### **3.49 Sound Level means**

*The conversion of sound pressure to a logarithmic measure called the Decibel.*

#### **Comments**

The conversion process may make use of various frequency weighting networks as specified by ANSI. When sound level is used without further description, A-weighting of sound pressure level may be assumed.

### 3.50 Sound Level Meter means

*An instrument, including a microphone, amplifier, RMS detector, and integrator, or time averager, output meter and weighting networks, all of which are sensitive to minute pressure fluctuations. When properly calibrated, the output meter reads sound pressure level. To be acceptable, the meter shall be Type 1 or Type 2 as defined by appropriate ANSI standards.*

#### Comments

Effective enforcement needs the assistance of sound measurement equipment to provide an objective measure of sound impact. The definition sets the minimum standards for the use of a meter that is acceptable in a court of law. Type 2 meters are not as accurate as Type 1 meters, cost less, and are generally acceptable for noise ordinance enforcement. See Appendix E for the various characteristics of these meters..

### 3.51 Sound Pressure means

*The instantaneous difference between the actual air pressure and the average or barometric pressure at a given location.*

#### Comments

Because sound pressures vary over an enormous range over very short periods of time, the instantaneous sound pressure of little use in an ordinance.

### 3.52 Sound Pressure Level ( $L_p$ ) means

*Twenty times the logarithm to the base ten of the ratio of the RMS sound pressure to the reference sound pressure which shall be 20 microPascals.*

#### Comments

This definition describes the conversion of sound pressure to sound pressure level in air. The level may be unweighted or weighted. If A-weighted, the term “sound level” is often used in place of this definition, but with the same meaning. When unweighted, the frequency range of any measurement is that of the instrument. Weighting changes the relative contribution of the various frequencies to the sound pressure level; unweighted levels are always higher than weighted levels.

### 3.53 Sound Reproduction Device means

*Any device, instrument, mechanism, equipment or apparatus for the amplification of any sounds from any radio, phonograph, stereo, tape player, musical instrument, television, loudspeaker or other sound-making or sound-producing device or any device or apparatus for the reproduction or amplification of the human voice or other sound.*

### **Comments**

So much noise impact is caused by sound making devices that many ordinances incorporate a definition similar to the one above to cover most possible ways to make sound.

### **3.54 Tenth Percentile Sound Level ( $L_{10}$ ) means**

*The A-weighted sound level that is exceeded ten percent of the time during a measurement period.*

### **Comments**

Environmental sound typically varies in time. This metric describes the higher levels experienced during the measurement period, and is to be compared with the Ninetieth Percentile Sound Level to establish the magnitude of noise impact. Depending on its intended use, the measurement period can be as short as ten minutes and as long as a sequence of hourly periods over twenty four hours. The measurement period should be the same as that for the Ninetieth Percentile Sound Level. Simple sound level meters are incapable of making these measurements. See Appendix C.2.6.

### **3.55 Vibration means**

*A temporal and spatial oscillation of displacement, velocity, and acceleration in a solid material.*

### **Comments**

Vibration has three impacts on listeners. A vibrating surface will generate sound that can be handled by sound level meters. A person in touch with a vibrating material may feel the motion. A person may observe the motion of vibrating objects. The first impact is excluded by the definition.

### **3.56 Vibration Perception Threshold means**

*The minimum ground or structure borne vibrational motion necessary to cause a person of normal sensitivity to be aware of the motion through contact or through visual observation of moving objects.*

### **Comments**

Loudspeaker cones may vibrate such high frequencies that the motion cannot be detected by touch. Most complaints about vibration are related to low frequencies where the impacts noted in Definition 3.55 occur. In that case, it becomes a matter of vibration amplitude. The ability for a person to detect vibration by touch or for object to move depends on the frequency of the vibration. The lower limit of detection is called the threshold. An example of these thresholds is given in Table 6-8.

### **3.57 Weekday means**

*Any day from Monday through Friday that is not a legal holiday.*

## Comments

Some ordinances not only set limits based on time-of-day but also on day-of-week. When this division is placed in an ordinance, it should be placed in provisions specific to a noise source and not in Article X (land use) standards.

## Article IV POWERS AND DUTIES OF (Official))

### 4.1 Lead Agency

*The noise control program established by this ordinance shall be administrated by (Agy).*

### 4.2 Powers of the Noise Control Officer (NCO)

*In order to implement and enforce this ordinance and for the general purpose of sound and vibration abatement and control, the NCO shall have, in addition to any other authority vested in him/her, the power to : (Add duties)*

## Comments

Although “program” may seem excessive, it relates simply to the fact that the ordinance will be enforced to the satisfaction of the citizens. The lead person’s title may also seem excessive. Regardless of the actual title (e.g., police officer) the use of this title in dealing with citizens helps them to be positive about the intentions of the community government.

### 4.3 Studies

*Conduct, or cause to be conducted, research, monitoring, and other studies related to sound and vibration.*

### 4.4 Education

*Conduct programs of public education regarding the causes, effects and general method of abatement and control of noise and vibration, explain the actions prohibited by this ordinance, and the procedures for reporting violations. Encourage participation of public interest groups in related public information efforts.*

## Comments

Public education, particularly among secondary school and university students, is an important part of any successful noise control program, as it has been with other programs such as drug abuse. The real goals of the ordinance are achieved if the importance of citizen knowledge is stressed within the ordinance. Public education can be two edged. It can sensitize citizens to no longer accept noise problems they formerly lived with, and may result in more complaints and potential headaches for community officials. If such complaints are valid, the goals of the noise ordinance will be met. It can overload community officials with excessive public relations efforts to the detriment of other assigned duties. In many cases, police officers visit schools to teach students about drug use, and guns; it is a simple matter to talk about being good neighbors by not creating excessive noise.

At times a person being disturbed by noise, or the person being accused of creating a disturbance, may ask a knowledgeable official for advice on how to solve a specific problem. The general rule is not to give such advice as that advice can be used as a defense in any action taken against the violator, especially if the advice was costly or ineffective. There are certain exceptions, such as a violation for excessive exhaust noise; a muffler is clearly an acceptable answer. The best response is to recommend an expert.

## 4.5 Coordination and Cooperation

*The duties of the lead agency shall be to:*

- *coordinate the noise and vibration control activities of all municipal departments.*
- *cooperate to the extent practicable with all appropriate state and federal agencies.*
- *cooperate to the extent practicable with appropriate county and municipal agencies.*
- *enter into contracts with other municipalities for the provision of technical and enforcement services.*

### Comments

Coordination and cooperation with other municipal agencies is necessary to handle the various types of noises that influence the health and welfare of citizens. Cooperation with state, county, and federal agencies brings the benefit of their experience, possible training by them, use of their equipment, and possibly funding. If the community has established a successful program, it may work in reverse: they will have developed personnel with experience and equipment that may be beneficial to neighboring communities. In every case, cost sharing reduces overall expenses.

## 4.6 Review of Actions of Other Departments

*Request any other department or agency responsible for any proposed or final standard, regulation, or similar action to consult on the advisability of revising the action, if there is reason to believe that the action is not consistent with the ordinance.*

### Comments

The internal control of municipal projects is a very important aspect of a noise control ordinance. Standards and regulations of other municipal departments should further the intent of the ordinance, not weaken it. In small communities, the various departments have individuals known to each other and internal cooperation is more likely to occur so the right of review may not be necessary to put into the ordinance. In large cities, a formal agreement is probably necessary. However, addition of this section to the noise ordinance may cause interdepartmental conflicts. The community may wish to additionally specify in the ordinance a method of resolving such conflicts by authorizing the city council, county board of supervisors, or mayor, to negotiate differences and make a final decision.

## 4.7 Review of Public and Private Projects

*Review public and private projects, subject to mandatory review or approval by other departments, for compliance with this ordinance, if such projects are likely to cause sound or vibration in violation of this ordinance.*

### Comments

This section is intended to cover the review of projects approved by other municipal departments, such as building permits and the granting of permits for parades and other special events, to ensure that noise is taken into consideration. A common example is a parade. Marching bands make acceptable and reasonable levels of sound, but some floats have loudspeakers with voice or music that are considerably louder and more intrusion on both the observers and other marchers.

## 4.8 Inspections

*(a) Upon presentation of proper credentials, enter and inspect any property or place, and inspect any report or records at any reasonable time when granted permission by the owner, or by some other person with apparent authority to act for the owner. When permission is refused or cannot be obtained, a search warrant may be obtained from a court of competent jurisdiction upon showing of probable cause to believe that a violation of this ordinance may exist. Such inspection may include performance of any necessary measurements.*

*(b) Stop any motor vehicle, motorcycle, or motorboat operated on a public right-of-way, public space, or public waterway reasonably suspected of violating any provision of this ordinance, and issue a notice of violation or abatement order which may require the motor vehicle, motorcycle, or motorboat to be inspected or tested as the NCO may reasonably require.*

### Comments

To be constitutionally permissible, administrative searches or inspection conducted by municipal inspectors on private property must be made using a warrant procedure. Thus if a private property holder refuses to allow his premises to be inspected by a municipal official, the official must obtain a search warrant for the premises before he may inspect them. Courts have held that there is no distinction between the rights of a residential property holder and those of a commercial property holder concerning searches or inspections. Both types of property are thus treated the same.

Violations of Article IX and most of Article VII can be determined without an inspection of the premises on which the sound source is situated, so a search warrant is not needed in these situations.

## 4.9 Records

*Require the owner or operator of any commercial or industrial activity to establish and maintain records and make such reports as the NCO may reasonably prescribe.*

### **Comments**

This section gives the NCO the authority to require the owners or operators of commercial and industrial activities to keep records and make reports reasonably related to the noise production of such activities. The records required may include the daily hours of operation, equipment malfunctions, and sound emission levels. The section does not apply to residential owners or operators.

## **4.10 Measurements by Owner or Operator**

*Require the owner or operator of any commercial or industrial activity to measure the sound levels of, or the vibration from, any source in accordance with the methods and procedures and at such location and times as the NCO may reasonably prescribe and to furnish reports of the results of such measurements to the NCO. The NCO may require the measurements to be conducted in the presence of enforcement officials.*

### **Comments**

This section can be of great use in the enforcement of the ordinance. Properly used, the provision provides a means of “self-enforcement” by the sound creator, thus relieving the NCO from the necessity of measuring each commercial or industrial source for a possible violation. The NCO may then conduct spot measurements to verify the validity of the reported data.. Residential sources are not covered.

## **4.11 Product Performance Standard Recommendations**

*(a) Develop and recommend, for promulgation to the appropriate authority, provisions regulating the use and operation of any product, including the specification of maximum allowable sound emission level of such product.*

*(b) Develop and recommend, for promulgation to the appropriate authority, provisions prohibiting the sale of products which do not meet specified sound emission levels, where the sound level of the product is not regulated by the United States Environmental Protection Agency under the Noise Control Act, as amended.*

### **Comments**

This section provides the authority to regulate the use and operation of any product. The ordinance then permits the NCO to study the source of noise in the community and determine which, if any, product creates a sufficient amount of noise disturbance to merit a separate control provision in the noise ordinance. It also permits the regulation of new sources which create noise disturbance. For example, it would permit control of a local dealer that sells motorcycles with modified mufflers which make excessive sound.

The second subsection provides the authority to recommend noise emission standards at the time of sale of new products sold in the community. Besides possible preemption problems, it may be difficult to define what a “new product” is.



## 4.12 Duties of the Noise Control Officer

*In order to implement and enforce this ordinance effectively, the NCO shall within a reasonable time after the effective date of the ordinance:*

*(a) Develop, recommend to appropriate authority, and promulgate standards, testing methods, and procedures.*

### **Comments**

To properly enforce a noise ordinance there must be a code of recommended practices which includes measurement procedures that are defensible. These are published separately from the ordinance and describe in detail how and under what conditions measurements are to be made and the specifications of required equipment. This code must be available to the public.

*(b) Investigate and pursue possible violations of this ordinance.*

*(c) Delegate functions, where appropriate under this ordinance, to personnel within the responsible department and other departments, subject to the approval of proper authority.*

*(d) Study the existing transportation systems, such as truck routes within the community; determine areas with sensitivity to sound and vibration caused by transportation vehicles; recommend modifications to those systems to minimize sound and vibration impact on residential areas and noise sensitive zones.*

### **Comments**

If interstate truck routes are changed, they cannot be changed to reduce community noise. They must be changed for other reasons (e.g., safety, road loads, and child safety).

*(e) Assist in, or review, the total transportation planning of the community, including planning for new roads and highways, bus routes, airports, and other systems for public transportation, to ensure that sound and vibration impact receives adequate consideration.*

*(f) Establish noise assessment guidelines for the evaluation of proposed improvements for the capital improvements budget. These guidelines shall be used to assign the relative priority of noise impact considerations.*

### **Comments**

This subsection requires municipal departments with responsibility for capital improvements budget to prepare an analysis of the noise impact of any proposed improvements. The analysis is to follow guidelines established by the NCO under this section. The guidelines help to establish the priority of noise impact on such capital improvements as building construction and road construction.

*(g) Prepare and publish with approval of appropriate authority, a list of those products manufactured to meet specified noise emission limits and federal, state or community law for which anti-tampering enforcement will be conducted.*



### **Comments**

Federal product noise emission standards may be enforced locally with this section. Federal and state anti-tampering laws can be enforced locally with this section.

*(h) Make recommendations to appropriate authority for modifications or amendments to the ordinance to ensure consistency with all state and federal laws and regulations.*

### **Comments**

As federal and state laws change, amendments to the community noise ordinance may be required.

*[(i) Develop a generalized sound level map of the community and a long term plan for achieving the goals of the ordinance to be integrated into the planning process of the community.]*

### **Comments**

A general sound map of a community is useful in determining the area most seriously impacted by noise, and in developing a plan to achieve the goals of the ordinance. It is also useful in assessing the progress made in achieving those goals. This is a large undertaking and may not be appropriate for smaller communities.

*(j) Administer noise program grants and other funds and gifts from public and private sources, including the state and federal governments.*

*(k) Make a periodic report on the effectiveness of the noise control program to appropriate authority. Make recommendations in the report for any legislative or budgetary changes necessary to improve the program.*

### **Comments**

Periodic reports call attention to the presence of the noise ordinance and tend to prevent neglect of ordinance existence.

## **Article V Duties and Responsibilities of Other Departments**

### **5.1 Departmental Actions**

*All departments and agencies shall, to the fullest extent consistent with other law, carry out their programs in such a manner as to further the policies of this ordinance.*

### **5.2 Departmental Cooperation**

*All departments and agencies shall cooperate with the NCO to the fullest extent in enforcing this ordinance.*

### 5.3 Departmental Cooperation with Other Laws

*All departments and agencies shall comply with federal and state laws and regulations and the provisions and intent of this ordinance respecting the control and abatement of noise.*

#### Comments

Sound measurements made from a balloon over a community revealed that the highest levels of sound were made by the local government. Sources of governmental noise can be street repair, garbage collection, fire sirens, ambulance sirens, police sirens, police helicopters, and exterior speakers on official vehicles. For a noise control program to be effective, municipal departments must make an effort to comply with the noise ordinance. An additional benefit in complying is the lessened noise exposure of municipal employees and potential claims for hearing damage. This section is a waiver of the sovereign immunity of the government. Historically, all governmental units were exempt from the application of tort law under the theory that “the King can do no wrong.” Many communities have controlled their sound sources with no detrimental effects on performance. The difficulty with vehicle sirens arises with the insurance companies who require them for “safety”.

### 5.4 Project Approval

*All departments whose duty it is to review and approve new projects or changes to existing projects, that result, or may result, in the production of sound or vibration shall consult with the NCO prior to any such approval.*

### 5.5 Contracts

*Any written contract, agreement, purchase order, or other instrument whereby the community is committed to the expenditure of at least (N) dollars in return for goods or services shall contain provisions requiring compliance with this ordinance.*

#### Comments

Choice of a minimum value is needed to separate routine and ordinary expenditures from larger expenditures where the health and welfare of citizens may be impacted.

### 5.6 Low Noise Emission Products.

*Any product which has been certified by the Administrator of the United States Environmental Protection Agency pursuant to the federal Noise Control Act as a low noise emission product and which is determined to be suitable as a substitute, shall be procured by the community and used in preference to any other product, provided that such certified product is reasonably available and has a procurement cost which is not more than (N) percent of the least expensive type of product for which it is certified as a substitute.*

#### Comments

The federal government is authorized to certify low noise emission products for those categories of products regulated under the Noise Control Act. The first categories were

construction and transportation equipment. By procuring low emission products for its own use, a community sets an example for private enterprise as well as reducing noise exposure to their own employees.

## **5.7 Capital Improvement Program**

*All departments responsible for a capital improvements budget and program shall prepare an analysis of the noise impact of any proposed improvements in accordance with noise assessment guidelines established by the NCO pursuant to section 4.12(f). Proposed capital improvements include land acquisition, building construction, highway improvement and utilities and fixed equipment installation.*

## Chapter 6

# Specific Provisions of a Community Noise Ordinance

*This chapter first discusses the various choices in writing provisions. It is followed by an extensive list of provisions which serve as a shopping list for ordinance components that address the environmental noise problems of a community. Each provision has a comments, references to existing noise ordinances, recommended values, and other relevant details. Many have several alternatives to accommodate the various ways an ordinance can be enforced. The issue of enforcement is covered in Chapter 7.*

### Introduction

The first reading of this chapter will leave the reader with the opinion that writing or modifying a noise ordinance hopelessly complex; there are too many ways to do it. This document attempts to cover as much relevant material about noise ordinances as possible in order to insure that when an ordinance is written it will be enforceable. Hopefully, having a list of noise problems to be addressed narrows the scope. Reviewing what other communities have done to address these problems should simplify some decisions. Most of the technical material about levels and methods has explanations and recommendations. The guidance in the sections immediately below should help the reader form an opinion on ordinance structure.

Each article is set out with a recommended format and in some, several alternative formats. The notations are as follows:

- **Alternative:** Several alternative wordings may be shown.
- **(N):** A number should be entered at this point.
- **(Agy):** The name of the responsible agency should be entered.
- **[xx]:** The wording between square brackets is optional.
- **Definitions Needed:** Numbers from Chapter 5.
- **Comments:** The text explains the meaning of the provision, how it relates to other provisions, and provides supportive data.
- **Existing Provisions:** Examples of provisions in existing ordinances and statutes.
- **Recommended Values:** A discussion of reasons for recommendations being made.
- **{xx}: Website Abbreviations**
  - {NFA} = Noisefree.org (Noise Free America)
  - {NOff} = Noiseoff.org (Noise Off)
  - {NPC} = Nonoise.org (Noise Pollution Clearinghouse)
  - {BD} = Barkingdogs.net

## Choosing the Provisions

### Subjective vs. Objective Provisions

There are two types of provisions; those associated with *subjective* response (disturbance of the peace), and those associated with *objective* measures quantified by maximum sound levels.

Subjective provisions have existed for a long time and are based probably on the preamble to the US Constitution: "...to insure domestic tranquility, provide for the common defence, promote the general welfare...". Practical application has revolved around the concept of nuisance, and the legality of nuisance provisions is well documented. The difficulty has been in establishing the reasonableness of any nuisance complaint. Some improvement has been made with the introduction of "*noise disturbance*" tying any complaint specifically to noise and broadening the meaning to more than just "unwanted". The use of "*plainly audible*" is a somewhat less subjective addition that can be used without recourse to a sound level meter. More detail is supplied in the definitions of Article III of Chapter 5. Subjective provisions are generally complaint-based but need not be. Provisions of this type are the backbone of most ordinances and can always act as a backstop to objective provisions. Both subjective and objective provisions are effective against stationary sources; objective provisions are best used for non-stationary sources, such as motor vehicles.

Objective provisions come in two forms: limitation of the sound *emission* from a source or limitation of the sound *immission* to a listener. Emission limitations apply in every direction from the source, so do not necessarily imply a specific listener, while immission limitations do imply a listener. Emission limitations are practical for moving sources, such as motor vehicles, but may cause excessive expense for stationary sources, such as commercial or industrial facilities, where residences may exist in only one direction. Immission limitations are based on the health and welfare of citizens and so have stronger justification and most ordinances use these. Immission provisions have two subtypes: absolute maximum levels or maximum levels relative to the ambient. See Fixed vs. Relative Maximum Levels below.

Although objective provisions provide defensible information about a violation, they cannot handle every possible situation. Subjective provisions must be incorporated into any ordinance to provide an alternative solution to those problems that the objective provisions cannot handle. **Both objective and subjective provisions in an ordinance are recommended.**

### Active vs. Passive Enforcement

The choice of a provision is strongly influenced by the intended method of enforcement. There are two methods: passive or active. Passive enforcement is complaint-based and is most effective against stationary and nearly continuous sound sources. Against moving sources, such as motor vehicles, passive enforcement works only against repeat offenders. Active enforcement is necessary against them. Since it is unlikely that measurements of moving sources will be made by listeners, they must be made by trained persons who are not actually the impacted persons. As a result, it is more difficult to establish disturbance without an objective and uniformly accepted, criterion for disturbance. This implies the need for numerical standards (maximum sound levels) and the equipment to make the required measurements.

## Separating or Combining Provisions

Many of the specific provisions listed separately in this chapter have been combined into a more general prohibition in a number of existing ordinances. The weakness of this approach is that the enforcing agency may have to justify that the provision applies to the specific situation; the alleged offender may claim he was unaware that it applied to him. Combining provisions does not allow for the peculiarities of each noise situation, particularly when curfews and numerical limits are applied. For example, a curfew on home use of power tools may be applied, while air conditioning units are exempt. Separate provisions are recommended.

## Allowable Time Periods

Most studies of noise impact have found that the day can be divided into three periods: day, evening, and night. The tolerance of noise diminishes as the day progresses. This is the basis for the Day-Night Average Sound Level (Appendix C.11.1). While most potential noise offenders accept the difference between waking and sleeping hours, they have problems with evening hours. As a consequence, most communities have only two periods; see the time categories in Appendix A. It is tempting to include a definition of day and night hours that apply to all potential noise intrusions. Examination of the provisions in this chapter suggests that one set of day/night periods does not always fit equitably to all situations. Where applicable, each of the provisions in this chapter lists specific periods separately. Consideration should be given to days-of-the-week. Some communities prohibit certain activities at any time on Sunday. Setting time categories, particularly for land use regulations (Article IX), is recommended.

## Fixed vs. Relative Maximum Levels

In the objective provisions, there are two ways to measure sound violations: a *fixed* maximum level (*fixed limit*) and a maximum level *relative* to the ambient (*ambient-plus limit*). The ordinance provision must define which method is to be used. The choice has impact on how the ordinance is to be enforced.

### Fixed Level Provisions

Setting a fixed maximum sound level is clearly applicable to moving motor vehicles as an *emission* limit. When it is applied to stationary sound sources as an *immission* limit, there can be a problem, particularly in residential areas. Even if the maximum level is considered reasonable, there will be times when, or areas where, the ambient itself is higher than the ordinance value. The source of interest must be considerably above the ambient in order to separate the ambient contribution from the source contribution. There are several approaches to handling this problem.

Set the maximum levels sufficiently high that it is unlikely for the ambient to exceed it. This approach requires either an arbitrary assumption or extensive measurements. It also does not satisfy the health and welfare goals of the community so no communities have taken it. It is best to set a fixed level maximum that meets health and welfare goals, regardless of ambient levels. Communities with fixed level provisions have used this approach. It has both advantages and disadvantages. The advantage is that only one measurement may be required. The disadvantage is that the ambient may interfere, and the source may be time varying. In most

cases based on complaints, the source can be readily identified and interference from the ambient is not an issue. In urban or industrial areas, the ambient level is higher and two measurements may be required: (1) an ambient measurement with the sound source off; and (2) one with the source on. This adds some complexity. The weakness is that it may not be possible to turn off the alleged source. Handling this problem is addressed primarily in Article IX and in Chapter 7. The time varying aspects are addressed in the Exceedance Allowance section below. There is a third approach that can be applied to cases where the ambient is above the maximum limits and the source has a constant level. It is based on the fact that true ambient sound comes from all directions, is fairly constant in level, is dominated by low frequencies, and is more acceptable than a specific sound source at the same overall sound level. It is similar to a sound masking spectrum used in commercial offices. If the total level is constant, is reasonably above the fixed level limit, and has a masking-like spectrum, the source is not considered a possible violation. This approach requires the use of octave band measurements and is discussed in Article IX. A more complete discussion is included Appendix A.3.6.

Fixed maximum levels are recommended since ambient problems can be resolved.

### **Relative Level Provisions**

Many older ordinances contain an ambient-plus X dB provision. This method *requires* two separate measurements at all times and so *every* alleged source must either be turned off or another means of measuring the ambient must be found. It is clearly applicable to stationary sources, not moving sources. This approach also has both advantages and disadvantages. The advantage is that it can handle situations in which the ambient level is quite high. The disadvantage is that the source must be turned off, or the ambient must be defined in another way. Further, some ordinances have set X to 3 dB. Albuquerque, NM uses X +5 dB. If the offending source raises the ambient by only three dB, it means the offending source was the same level as the ambient and therefore not in violation. Handling this and other aspects is addressed in this chapter and in Chapter 7.

## **Exceedance Allowance**

How much, and how often, can the sound be over the limit to be acceptable? Three factors play a role here. As with speed limits, an unofficial allowance is given to insure against arguments about inaccuracy (reflections, ambient, meter calibration). Since the sound level in almost every environment changes from moment to moment, readings on a sound level meter will also change. What is the applicable level? Sound sources that are on continuously have more impact than ones that are on for a short time and the level can be determined readily. Many sources will vary with time. A small, but short, level increase over the maximum (a shout) is clearly not a cause for violation. A large, but short, level increase (a gunshot) is. An allowance for reasonable intermediate levels and times needs to be addressed in the ordinance. In some cases, excess sound is permitted for a certain percent of time (e.g., 15 minutes in an hour). Some communities have a table that sets the allowable exceedance level that varies with the amount of time the exceedance occurred. In other cases, a more sophisticated approach is used. Both the time and excess level are specified ( $L_{10}$  vs.  $L_{90}$ ). See Appendix C.2.6. These aspects and the unofficial allowances are addressed in this chapter. Providing an exceedance allowance makes fixed maximum level provisions enforceable and defensible.



## Character Allowance

Most sound measurements are made with a meter that integrates the sound from all frequencies and weights them in accordance with the sensitivity of the ear. They do not evaluate the quality of the sound perceived by the listener. There are two sounds listeners consider to be less acceptable than random sound: pure tones and impulsive sounds. Pure tones are technically a single frequency, but most sources with a dominant tone also have harmonics of that tone. Since the word “pure tone” is in common use, its definition has been broadened to include harmonics and methods for technical definition of a pure tone (Definition 3.41). In many cases, listening alone is sufficient to establish the existence of a tone. Impulsive sounds elicit a startle response that is always negative. Reduction of allowable maximum levels for these sources is recommended; Provision 9.2 addresses it.

## Choosing Immission Levels

*Immission* levels are those chosen to protect the health and welfare of inadvertent listeners, such as those in residential zones. Appendix A shows maximum immission levels commonly chosen by states and communities. Since these levels have been in existence for at least thirty years, they are considered reasonable and enforceable. There are several methods of measuring sound levels that may be in violation, but they do not require adjustments in the maximum levels set in the ordinance. Article IX also provides recommended levels.

## Choosing Emission Levels

Good noise ordinances also regulate *emission* levels (the sound output) of a number of sound sources. Examples are motor vehicles of all types, watercraft, and construction sites. The chosen maximum level for these sources will have impact on how **far away** the chosen immission levels can be achieved. Table C-9 in Appendix C shows the distances for various source levels and desired environmental levels.

Many vehicle limits are between 75 and 85 dB(A) at 50 feet (Appendix B). The impact is on the order of **hundreds of feet**, which can be shortened with the use of highway berms. Isolated vehicle passes on residential streets are short term so contribute little to the average noise exposure of a resident. Florida, on the other hand, has set a maximum of 90 dB(A) at 50 feet for airboats. The radius of the noise impact is on the order of **miles** and the area impacted is more like three times the square of the radius. It is important to take into consideration the distance impact of the chosen level when trying to balance the health and welfare of citizens with the arguments that any regulation will put the noisemaker out of business, is technically infeasible, or will have negative impact on the local economy. Taking into account technical feasibility, economic impact, noise impact distance, and noise impact duration is recommended when setting emission maximum levels. Technical feasibility is always a difficult aspect. Motorcyclists in the 1970's claimed noise reduction was technically impossible until a quiet BMW appeared. Stationary sources, such as air compressors can be housed will motor vehicles cannot.



## Summary

Table 6-1 provides a summary of the various possible provisions and the required information.

Decision Matrix for Provisions					
Subjective		Objective			
Noise Disturbance	Plainly Audible	Immission Limits			Emission Limits
Distance	Distance	Fixed Levels		Relative Levels	Fixed Levels
Allowable Period	Allowable Period	Exceedance Allowance	Character Allowance	Exceedance Allowance	Character Allowance

**Table 6-1. Various options for noise ordinance provisions**

## Article VI NOISE DISTURBANCE PROHIBITED

*No person shall make, continue, or cause to be made or continued, any noise disturbance. Unamplified, non-commercial public speaking and public assembly activities conducted at conversational voice levels on any public property or public right-of-way shall be exempt from the operation of this article if such sound is not plainly audible beyond (N) feet or does not infringe on the legitimate rights of others.*

### Definitions Needed

3.29, 3.34, 3.36, 3.39, 3.40

### Comments

This article is a version of those provisions variously called “disorderly conduct”, “public nuisance”, “private nuisance”, “disturbance of the peace”, “unnecessary noise”, “unreasonable noise”, “loud noise”, “raucous noise”, or “unusual noise”. It is intended to update and improve the numerous provisions in older ordinances. It utilizes the criteria of “noise disturbance” which includes more than just “unwanted sound” (Definition 3.29). The wording gives the essentially subjective prohibition a narrower interpretation and provides a better defined criterion. It does not refer to the content of the sound source nor to the time when the disturbance occurs, so it is completely generic and should be used as support for the more specific provisions listed in this chapter, i.e., the objective provisions should always be used in preference to this provision. As a result, it is important to consider the particular potential sound sources in the community and include provisions that specifically address them. Subjective provisions that include specific places, times, and locations reduce the vagueness and increase the effectiveness of the provision.

One of the most used objections to this provision is that it limits free speech (See Chapter 4.4). The latter part has been included to avoid problems with the First Amendment to the U.S. Constitution where there must be a balance between the right to free speech and the infringement on the rights of others. Prohibiting public speaking per se is not permitted, but it can be limited when it interferes with the legitimate right of others. This provision adds “conversational level” to restrict the radius of understanding by limiting shouting that can impose on the rights of unwilling and inadvertent listeners.

## Recommended Values

This provision should be included in any noise ordinance. The value of **N** is recommended to be 100 feet. See Table 6.2 and the reasoning for this number in Provision 7.1.

## Article VII SPECIFIC PROVISIONS

*The following acts and the causing thereof are declared to be in violation of this ordinance:*

### Comments

This article addresses possible sound sources in a community that may be very difficult to measure practically or objectively with Article IX on stationary sources or Article X on moving sources. Since the method of addressing each source is different it is recommended that each existing potential problem in the community be included separately in the ordinance in addition to Articles VI, IX and X. The primary purpose of separating these provisions is to provide *fair warning* to potential violators and to provide specific guidance to enforcers to avoid *arbitrary and discriminatory enforcement*.

### 7.1 Radios, Television sets, Musical Instruments, and Similar Devices

*Operating, playing or permitting the operation or playing of any radio, television, phonograph, drum, musical instrument, sound amplifier, or similar device which produces, reproduces, or amplifies sound:*

*(a) between the hours of (N<sub>1</sub>) PM and (N<sub>2</sub>) AM the following day in such a manner as to create a noise disturbance or be plainly audible across a real property boundary in a residential zone or in a noise sensitive zone, or plainly audible at a distance of (N<sub>3</sub>) feet on a public right-of-way or on public property. [except for activities open to the public and for which a permit has been issued by appropriate authority], or;*

*(b) in such a manner as to create a noise disturbance or to be plainly audible to any person other than the operator of the device, when operated by any passenger on a common carrier.*

*(c) This provision shall not apply to non-commercial speech covered under Provision 7.2 or to vehicle sound systems covered in Provision 10.5.*

### Definitions Needed

3.5, 3.29, 3.30, 3.36, 3.42, 3.45

### Comments

This is a *subjective immission* control and applies to unlicensed *amplified* sound from stationary source that is a *byproduct* of someone listening to material that happens to be heard by others. Provision 7.2 relates to *deliberate* sound generation to be heard by others where First Amendment rights may apply. The source may be located on private or public property as can the listeners. It may be restricted to residential zones, or to any property line. Provision 7.20 applies to unlicensed sound that is a *byproduct* of someone listening to material that happens to

be heard by others *within* a multi-tenant building. Provision 10.5 applies more specifically to vehicles which may also be in motion.

This provision has some important differences from similar provisions in existing ordinances. It uses the term “noise disturbance” so that it relates only to noise. It adds the useful and definable term “plainly audible”. It is a means for a person, or an NCO, to more acceptably and defensibly determine if a noise disturbance exists without recourse to a sound level meter.

### **Existing Provisions**

Los Angeles, CA covers this subject in three ways. It has a prohibition against noise disturbance, levels are not permitted to the limit by 5 dB, and the sound may not be audible 150 feet beyond the property line of the *source* in a residential district. In Seattle, WA, and Chicago IL, the sound must not be plainly audible at 75 feet. Salt Lake City uses several methods. The first method is to use the maximum levels set in Article IX. The second method is to determine if it is plainly audible at the listener property line between 10 pm and 7 am. The third is to determine if it is plainly audible on public property at 50 feet between 7 am and 10 pm. Atlanta, GA limits levels to plainly audible at *any* distance on public property and at 50 feet in residential, commercial, or industrial zones. In Boston, MA, at residential property lines, the level cannot be greater than 50 dB(A) between 11 pm and 7 am and not greater than 70 dB(A) at other times. Miami, FL, Omaha, NE, and Buffalo, NY limit levels to plainly audible at 100 feet; Green Bay, WI and Indianapolis, IN set the distance at 75 feet; Albuquerque, NM sets the distance at 25 feet. Charlotte, NC limits levels to a maximum of 55 dB(A) at residential property lines between 9 am and 9 pm and 50 dB(A) at other times. Burlington, VT sets the limit as plainly audible at property lines between 10 pm and 7 am. Hammond, IN restricts levels to plainly audible at the property line. Albany, NY requires a permit from the Chief of Police. New Jersey has a more complex regulation. From 10 pm to 7 am on weekdays, or from 11 pm to 9 am on weekends, the ambient may only be increased by 3 dB(C) and at other times by 6 dB(C). New Mexico permits communities to regulate amplified sounds. Austin, TX requires a permit for any devices that can be heard in any public place. Colorado Springs, CO permits confiscation for a third offense. New Orleans, LA sets maximum levels of 80 dB(A) at 55 feet. Boulder, CO (Boulder Revised Code 5-3-11) extends this provision beyond noise to nuisance parties:

“No owner, occupant, tenant, or other person having possessory control of any premises shall sponsor, conduct, host, or permit a social gathering or party on the premises which is or becomes a public nuisance where such nuisance is either the intentional result of, or reasonably anticipated by, the person or persons having such possessory control.” They add a note: “If a social gathering violates one or more of the 23 municipal ordinances listed in this code section, including all of the noise, trash and alcohol ordinances, a police officer may declare the gathering a nuisance party. It is also a violation of this code to remain at a property when declared a nuisance party by a police officer. It is up to the officer to determine if a nuisance is occurring at a gathering based on the totality of the circumstances. Some of the circumstances used to make the nuisance determination include the size of the gathering, number and types of violations to the Nuisance Party ordinance, and the level of cooperation received.”

## Recommended Values

There are two choices: *noise disturbance* and *plainly audible*, as the determinants of sound level. It is recommended that both terms be used in the provision. The first would be based on a complaint and applies to any type of sound. The second would be based both on the complainant as well as the enforcing officer and would apply to sounds that are easy to define such as speech or music. The values of  $N_1$  and  $N_2$ , if inserted, should be consistent with other provisions, such as those in Article IX and be applied to residential zones. Implied with these time limits is that any level is acceptable at other times. **A time restriction is not recommended.**

Average conversational levels are near 70 dB(A) at one meter so a reasonable maximum sound level for intelligible listening would be 80 dB(A). For that case, the maximum sound levels at several distances are shown in Table 6-2. When the sound from the source is approximately the same as the ambient, it becomes difficult to say it is plainly audible. Most reasonable community ambient levels (and maximum land use levels) are between 50 and 55 dB(A), so the distance to reach it is between 50 and 100 feet. **It is recommended that the value of  $N_3$  be 100 feet.** It should be applicable at all times.

Distance, Feet	10	25	50	100	150
Level, dB(A)	70	62	56	50	46

**Table 6-2 Decay of speech level with distance**

## 7.2 Public Address Systems

*Using or operating:*

(a) *for any non-commercial purpose, any loudspeaker, public address system, or similar device such that the sound therefrom creates a noise disturbance or is plainly audible across a real property boundary in a residential zone or in a noise sensitive zone, or is plainly audible at a distance of ( $N_3$ ) feet on a public right-of-way or on public property, or;*

(b) *for any commercial purpose, any loudspeaker, public address system, or similar device between the hours of ( $N_1$ ) PM and ( $N_2$ ) AM the following day on a public right-of-way or public property, or such that the sound therefrom creates a noise disturbance or is plainly audible across a real property boundary in a residential zone or in a noise sensitive zone, or is plainly audible at a distance of ( $N_3$ ) feet on a public right-of-way or on public property at other times.*

### Definitions Needed

3.29, 3.30, 3.36, 3.39, 3.40, 3.42, 3.45

### Comments

This is a *subjective immission control*. It is intended to cover *deliberate* propagation of sound as opposed to the unintentional sound of the previous provision, and is subject to First Amendment rights. The expanded use of sound amplifying equipment has resulted in the widespread use of exterior public address systems in car dealerships, garages, race tracks, sporting events, music festivals, on motor vehicles, and on vehicles for communication between a central office and the driver who is outside a standing vehicle. Race tracks, sporting events,

and music festivals are generally confined to a stadium and they must be treated differently (7.21 and 10.12). Typically, the gain is set much higher than necessary to achieve communication so community noise impact can occur. This provision acts as a backstop to the objective numerical limits in Article IX. Subsection (a) narrowly regulates speech to avoid constitutional problems while protecting citizen health and welfare during the most sensitive hours of the day. Note that the provision has three tiers of specificity. The generalized “noise disturbance” is the least defensible, but the two “plainly audible” parts should be defensible in court. No curfew has been added.

Commercial speech has been given less protection by the US Supreme Court, so commercial speech has been separated from non-commercial speech. Subsection (b) provides more stringent regulation of commercial loudspeakers by placing a curfew on their use on public property.

### **Existing Provisions**

Lakewood, CO limits sound to plainly audible across property lines from 10 pm to 7 am, and it must be “reasonable” at other times. Los Angeles, CA uses the ambient criteria of the Table A-22 in Appendix A.3.6 and allows a 5 dB excess if the source is on 15 minutes or less in one hour. Seattle, WA uses the plainly audible criterion. Atlanta, GA uses the plainly audible criterion in residential districts at the property line between the hours of 10 pm to 7 am on weekdays and 10 pm and 10 am on weekends and holidays. Albuquerque, NM requires that “volume” restrictions be set on amplifiers, and once set must be mechanically limited to prevent being overridden. They also restrict operation to daytime hours and if two or more violations within a two year period, the devices must be removed. Boston, MA prohibits loudspeaker use on public property and in residential zones. Madison, WI prohibits such activity from 12 pm to 1 pm and from 5 pm to 7 pm. Minneapolis MN prohibits such activity from 9 pm to 9 am; at other times it must be less than 90 dB(A) at 50 feet, or less than 15 dB over the ambient. Albuquerque, NM uses ambient plus 5 dB at the property line as the limit and restricts use to daytime hours. San Jose, CA prohibits all amplified sound projected out from buildings or outdoors unless a permit is granted. Detroit, MI prohibits sound audible beyond 100 feet or sound created less than 250 feet from a residence. In Kenosha, WI any noise disturbance in residential zones between 10 pm and 8 am from a loudspeaker is a violation and a noise disturbance on public property between 5 pm and 8 am is a violation. Omaha, NE sets the plainly audible limit at 100 feet. Charlotte, NC limits levels to 60 dB(A) at 50 feet between 9 am and 9 pm and 50 dB(A) at other times. In New Jersey it is a violation if the sound is plainly audible at 50 feet between 8 am and 10 pm and plainly audible at 25 feet between 10 pm and 8 am. Connecticut exempts bells, carillons, or chimes associated with religious services, whether amplified or not. When music is played, the bass sound is often dominant, so Hawaii limits such sound to 60 dB(C) during daytime hours and 50 dB(C) at night in any land use zone. Austin, TX requires a permit for any devices that can be heard in any public place. Indianapolis, IN restricts the use of sound devices broadcasting from *aircraft* (Sec. 391-505) to music and speech between 11:30 am to 1:30 pm and between 4:30 pm to 6:30 pm. Mobile, AL prohibits sound trucks. New Orleans, LA exempts only *non-amplified* church bells and chimes. New York City (24-220) prohibits transmission from airplanes as well as from boats. Orlando, FL requires permits for outdoor speakers and restricts use to daytime hours and at least 1000 feet from noise sensitive zones. They also require drive-in facility speakers within 300 feet of residences to be faced away from them. Phoenix, AZ prohibits vehicle speakers for advertising *or other purposes*.

## Recommended Values

It is clear that there is a multiplicity of existing options for this provision. Day-of-week options must be local, so no recommendation is given here. The curfew hours  $N_1$  and  $N_2$  should be consistent with the time limits in Article IX. Since most broadcast is either speech or music, the plainly audible criterion is useful to avoid meter use. **The value of  $N_3$  is recommended to be 100 feet.** See Provision 7.1.

## 7.3 Street Sales

### Alternative 1

*Offering for sale or selling anything by shouting or outcry within any residential or commercial zone except by permit issued by appropriate authority.*

### Alternative 2

*Offering for sale or selling anything by shouting or outcry within any residential or commercial zone between the hours of ( $N_1$ ) PM and ( $N_2$ ) AM the following day.*

## Definitions Needed

3.6, 3.45

## Comments

This provision is a *subjective emission* control; it is not related to any specific listener. Shouting or outcry is transient and possibly associated with a slow moving vehicle, so it is very difficult to establish noise disturbance as compared to that from continuous or amplified sounds. Alternative 1 permits outcry at any time only by persons with permits. Alternative 2 restricts outcry to daytime hours whether the person has a permit or not. Restriction by zone and time is a practical and defensible method of control. Authorized public events are exempted and permits should be consistent with other permit procedures.

## Existing Provisions

Atlanta, GA allows street sales by permit and has no noise disturbance provision. Boston, MA prohibits street sales near schools or churches if there is a “disturbance of the peace”. Hammond, IN places a curfew between 6 pm and 9 am. Connecticut exempts “unamplified sound of the human voice” from regulation, presumably to avoid Constitutional issues (See 4.3.5 of Chapter 4).

## Recommended Values

This provision is difficult to enforce so a curfew is recommended. The times  $N_1$  and  $N_2$  should be consistent with the time limits in Article IX.

## 7.4 Animals

*(a) Owning, possessing, or harboring any animal which howls, barks, meows, squawks, or makes other sounds continuously for over ( $N_1$ ) minutes, or intermittently for over ( $N_2$ ) minutes and creates a noise disturbance across a real property boundary in a residential zone or in a noise sensitive zone. [This provision shall not apply to (add list of exemptions)].*

(b) Repeat offenders must have an anti-barking collar installed on their dogs.

### Definitions Needed

3.29, 3.30, 3.42, 3.45

### Comments

This provision is a *subjective immission* control. The word “animals” covers all types of common animals as well as the more exotic animals rarely found in residential areas. Again such sounds are typically transient, even if occurring continually. Dogs barking are the most common complaints. It is possible, but impractical, to measure the impulse sound level of a dog. As yet, no one has defined an objective maximum impulse level. Because of the variety of dog types, and the variety of frequency spectra that encompass barks, it would be very difficult to provide a provision with a maximum A-weighted sound level. Since the source is readily identifiable, it is not necessary to use the “plainly audible” term. In addition, the sound may be gone between the time of a complaint and the response by an NCO. Most existing animal provisions can be attacked for vagueness (See 4.3.3 of Chapter 4). The addition of the times in this provision provides the owner with *fair warning* and avoids *arbitrary and discriminatory enforcement*.

Animal pounds, kennels, and veterinary facilities, if poorly located, can be a cause of severe community annoyance, and this provision has an option to exclude include them. The best resolution, however, is proper site selection during the approval phase for the facility. The list of exemptions must be carefully chosen to avoid, for example, the impact of kennel sounds on a nearby residential area and any resultant nuisance litigation.

### Existing Provisions

Atlanta, GA uses “excessive noise” across a residential or commercial property line as the criterion. They define excessive as continuous sound for 10 minutes or more or intermittent sound for 20 minutes or more. There are no time limits. Boston, MA considers it a violation if the sound “is so unreasonably noisy as to disturb the peace”. New Jersey considers it a violation if the sound is continuous for more than 5 minutes or intermittent for more than 20 minutes. New Jersey and Colorado Springs, CO consider it a defense against violation is if the animal has been provoked to bark by the complainant. Colorado has a detailed provision on animal sound (6.7.115). Albuquerque, NM defines excessive as 10 or more minutes of continuous sound. New York City requires the sound to be plainly audible but sets different time limits; from 7 am to 10 pm 10 minutes is the limit, while from 10 pm to 7 am on 5 minutes is allowed. {NFA} has 19 articles about barking dogs in particular. {BD} is a comprehensive site devoted entirely to barking dogs; it is worth reviewing with regard to regulations on this issue. There are a number You Tube and Goggle videos that show methods for quieting dogs and the use of anti-barking collars. Connecticut exempts animal sounds. Anchorage, AK allows a continuously violating animal to be taken and made available for adoption.

### Recommended Values

Using Article IX on land use is not applicable to this problem, so a separate provision on animals is recommended. A curfew is **not** recommended as annoyance with barks occurs at any time of day. Following Atlanta, GA, **it is recommended that  $N_1$  be 10 minutes and  $N_2$  be 20 minutes.**

## 7.5 Loading and Unloading

*Loading, unloading, opening, closing, or other handling of boxes, crates, containers, building materials, garbage cans, or similar objects, between the hours of (N<sub>1</sub>) PM and (N<sub>2</sub>) AM the following day, or in such a manner as to cause a noise disturbance across a real property boundary in a residential zone or in a noise sensitive zone.*

### Definitions Needed

3.29, 3.30, 3.42, 3.45

### Comments

This provision is a *subjective immission* control. There are several possible versions. It can prohibit a noise disturbance throughout the day; it can exempt the activity during the day and prohibit a noise disturbance at night; it can exempt the activity during the day and apply a curfew at night; it can prohibit a noise disturbance during the day and apply a curfew at night. It applies to both private and commercial activities including interstate vehicles. The sound from refuse collection vehicles is addressed in Provision 10.10. Since enforcement of this provision is based on complaints, it may not be necessary to incorporate a curfew provision, although such a provision would provide *fair warning* to a potential offender.

### Existing Provisions

Los Angeles, CA places a curfew on this activity between the hours of 10 pm and 7 am but *only* if the source is within 200 feet of any residential unit. Chicago, IL considers it a noise disturbance if the activities occur between 10 pm to 7 am. Dallas, TX exempts loading/unloading activities between 7 am and 10 pm. Hammond, IN prohibits noise disturbance between 7 pm and 7 am.

### Recommended Values

Incorporating a curfew is helpful for potential noise offenders to manage their activities and is recommended. Incorporating a distance criterion is difficult for both the potential offender and the NCO. The times N<sub>1</sub> and N<sub>2</sub> should be consistent with Article IX and Provisions 7.1 and 7.2, if those provisions have time limits.

## 7.6 Construction

### Alternative 1

*Operating or permitting the operation of any tools or equipment used in construction, drilling, or demolition work:*

*(a) between the hours of (N<sub>1</sub>) PM and (N<sub>2</sub>) AM the following day on weekdays or at any time on [Sundays/weekends], or legal holidays, such that the sound or vibration therefrom creates a noise disturbance across a real property boundary in a residential zone or in a noise sensitive zone, except for emergency work of public service utilities or by special variance, or;*



(b) at any other time such that the sound pressure level across a real property boundary in a residential zone or in a noise sensitive zone exceeds ( $N_3$ ) dB(A) [ for more than ( $N_4$ ) minutes in ( $N_5$ ) minutes], or;

(c) in violation of any state or federal law or regulation.

(d) This provision does not apply to domestic power tools in use on an owner's property.

## Alternative 2

(a) Operating or permitting the operation of any tools or equipment used in construction, drilling, or demolition work which exceed the sound level limits for industrial land use as set forth in Article IX, between the hours of ( $N_1$ ) PM and ( $N_2$ ) AM the following day, except that the sound level limits shall apply for all construction in all land use categories, or;

(b) in violation of any state or federal law or regulation.

(b) This provision does not apply to domestic power tools in use on an owner's property.

## Definitions Needed

3.1, 3.7, 3.12, 3.15, 3.18, 3.29, 3.30, 3.42, 3.45, 3.49, 3.55, 3.57

## Comments

This provision has both an *objective and subjective immission* control aspects. There are several types of construction that can create high levels of sound: (1) public highway/street work; (2) large building construction; and (3) small building or residential construction. Public street work is generally done under license, and large building construction is done primarily in large urban centers, also under license. This provision is intended primarily to address small building or residential construction. Balancing the important need for construction with the health and welfare of its citizens can be a difficult decision for community managers. Many communities attempting to regulate construction noise have met with strong resistance from the construction industry; they believe

SOURCE	Approximate Level at Operator	Approximate Level at 50 Feet
<b>Earth Moving</b>		
Front End Loader	88	64
Back Hoe	86	62
Bull Dozer	96	72
Roller	90	66
Scraper	96	72
Grader	85	61
Truck	96	72
Paver	101	77
<b>Material Handling</b>		
Concrete Mixer	85	61
Concrete Pump	85	61
Crane	100	76
Derrick	85	61
<b>Power Units</b>		
Generators	85	61
Compressors	85	61
<b>Impact Tools</b>		
Pile Driver (diesel/pneumatic)	98	74
Pile Driver(gravity/bore)	83	59
Pneumatic Breaker	106	82
Hydraulic Breaker	95	71
Pneumatic Chipper	109	85
<b>Other Equipment</b>		
Vibrator	95	71
Compressed Air Blower	104	80
Power Saw	88	64
Electric Drill	102	78
Air Track Drill	113	89

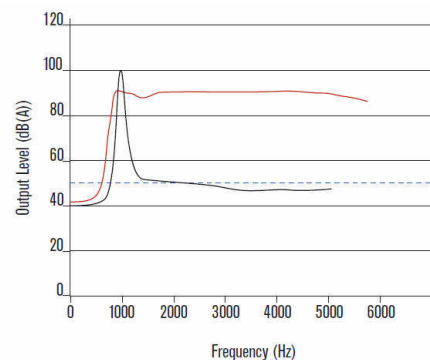
**Table 6-3. Sound levels of construction equipment**

that noise regulations unreasonably restrict their activities and profitability. Since the noise problem is real, it is important to involve construction companies in the development of any ordinance. See Phase II in Chapter 2.

There are four major sources of sound: (1) the direct sound emission of an operating machine/tool (air compressor); (2) the sound generated by machine/tool use (jackhammer); (3) backup alarms; and (4) the sound of hauling equipment both on and off site. Also, home construction in residential areas often results in extremely loud radios; but that is covered by Provision 7.1 or Article IX. The US Environmental Protection Agency has indentified construction equipment as a major noise source. There are emission regulations on portable air compressors that have more than 775 cfm and more than 50 psi (40 CFR 204); operational maximum levels are 76 dB(A) at 25 feet. Since these regulations apply to new equipment, maintenance of the equipment to retain the sound level limits is important since there is a federal anti-tampering law. Tampering is addressed in Provision 7.18. However, the sound output of a site is determined by the mix of products and the number of each. The Table 6-3 shows some approximate sound levels created by various items of construction equipment. Although manufacturers continue to improve the noise reduction characteristics of their products, the high power, velocities, or impacts of the equipment makes them a definite community sound source.

Contractors, in order to reduce costs when bidding on projects, will plan to rent from the lowest equipment bidder, not the quietest equipment bidder. Construction has a competitive environment, so labor unions do not make a big issue about hearing conservation for their members. The performance of mufflers decays with time and contractors are reluctant to spend funds replacing them. It should be clear that setting a local *emission* control of construction equipment or operations for all types of sites is not practical or enforceable for a smaller community. However, it is possible to include noise level restrictions in public contracts. Executive Order 12088 of 1978 requires federal facilities and activities to comply with the Noise Control Act of 1972 which provides some pressure on contractors to comply.

Backup alarms are mandated by the federal government. They state “*No employer shall use any motor vehicle equipment having an obstructed view to the rear unless: (i) the vehicle has a reverse signal alarm audible above the surrounding noise level....*” (29 CFR 1926). Most backup alarms are tonal in the mid frequencies and there is some argument that blind and hard-of-hearing persons have difficulty locating them. More recent alarms have a broad band characteristic claimed to reduce this effect. Figure 6-1 shows a sound spectrum comparison of the two types. The broadband sound has the same overall level, but is more detectable because it has a broader frequency spectrum. In addition, audibility decays with distance more rapidly than for a tonal alarm, reducing community impact. Typical



**Figure 6-1. Frequency spectrum of backup alarms**

Distance, Feet	Level, dB
3	95
10	85
25	77
50	71
75	67
100	65
125	63
150	61
200	59
250	57

**Table 6-4. Decay of backup alarm sound with distance**

operation is intermittent during backup. What is the important level? The federal regulation is ambient-plus, and consensus suggests that ambient + 10 dB is sufficiently audible.

Some manufacturers recommend levels between 80 and 100 dB at 1 meter. The Table 6-4 shows the sound decay with distance for a source level of 95 dB at one meter. At 25 feet the alarm should be audible. The distance at which the level approaches the typical residential ambient is on the order of 250 feet. Backup alarms, although required and necessary, create additional community noise impact.

Material hauling vehicles are typically quite large and heavy and result a high levels of roadway sound if not properly muffled. When off-site, the provisions of Article X apply.

The negative response of people to construction noise can best be put into the framework of “Common Questions about Sound” in Chapter 3. The sound is seldom made on behalf of the listener, it is not normal for the environment, it is unlikely that anything is being done to control it, the pitch of backup alarms is annoying and impulsive sounds can be frightening. Contractors like to start construction work early in warmer climates, often earlier than the local residents are prepared to accept. Similarly, night or weekend work creates a strong negative response.

Regulating the construction side sound *emission* would be exceedingly difficult in that it would apply in all directions, and the mix of sound sources would be highly variable. *Immission* controls are the only feasible regulatory approach. Communities can control construction noise by time restrictions, location restrictions, barrier construction for nearby residences, licensing, certification, but **not** sound emission levels of specific equipment. Item (a) of Alternative 1 implies that no restrictions apply during daylight hours on weekdays, but prohibits noise disturbance outside noise sensitive or residential zones at other times and days. Item (b) can be added to apply level restrictions during the otherwise unrestricted times. Item(c) is addressed separately in Provision 7.16 since there are a number of domestic tools not concerned with construction. The hours of restriction should be consistent with those in other provisions of the ordinance. Alternative 2 implies that there are no restrictions during working hours at any day of the week and the maximum levels associated with industrial land use (Article IX) apply during night hours. Alternative 2 is less restrictive than Alternative 1 and is an objective standard rather than a subjective one. Various combinations of level, times, and day can be used to modify these provisions locally.

### **Existing Provisions**

Seattle, WA (Sec. 25.08-425) divides construction equipment into specific categories and places limits for each category. Impact devices have a special category and a more complete specification of allowable sound emission levels. Blasting sounds are exempt during daytime hours. In Boston, MA, construction is allowed only between 7 am and 6 pm on weekdays. Madison, WI limits construction equipment to 88 dB(A) at 50 feet. If construction in Miami, FL occurs between 6 pm and 8 am on weekdays or any time on Sunday, it is in violation if it creates a noise disturbance in residential zones or noise sensitive zones. Albuquerque, NM requires sound control devices as effective as those of the original equipment, and compliance with Public Works measures which delineate times and levels that are acceptable. Fort Collins, CO permits construction between 7 am and 8 pm without restriction and applies land use maximum levels at other times. Cincinnati, OH prohibits construction between 11 pm and 7 am that creates a noise disturbance or is within 500 feet of a residence unless a permit is issued. Dallas, TX limits construction near residential zones to 7 am to 7 pm on weekdays, 9 am to 7 pm on Saturdays and holidays, and prohibits construction on Sunday. Houston, TX restricts levels to 75

dB(A) at residential property lines from 7 am to 8 pm and land use levels [58 dB(A)] at other times. Maryland permits up to 90 dB(A) at residential property lines during the day and restricts levels to those in land use [55 dB(A) in residential zones] at night. Boulder County, CO restricts construction levels at residential property lines to 80 dB(A) from 7 am to 7 pm and 75 dB(A) at other times. Charlotte, NC prohibits construction less than 300 feet from residences between 9 pm to 7 am. In New Jersey, construction activity is exempt from 7 am to 6 pm on weekdays and from 9 am to 6 pm on weekends. Land use regulations apply at other times. Connecticut exempts all construction sound. Hawaii exempts construction noise only during limited time periods during each day of the week; at other times the land use standards must be met. Maryland exempts all construction or repair work that is done on public property. Maryland limits the sound emission from a construction site to 90 dB(A). Albuquerque, NM (§9-9-8) prohibits construction and demolition within 500 feet of a noise sensitive property (residences included) if the equipment sound control devices are less effective than the original equipment and if noise mitigation measures are not used when the levels exceed 90 dB (weighting not specified) or more than 80 dB during the day for three days. Colorado Springs, CO applies Article IX levels for construction between 9 pm and 7 am on weekdays, and between 5 pm and 8 am on weekends. Hartford, CT exempts construction on weekdays from 7 am to 6 pm. Louisville, KY exempts construction and demolitions activities between 7 am and 9 pm. New York City, NY limits air compressor sound to 80 dB(A) and paving breakers to 95 dB(A), both measured at 1 meter.

### Recommended Values

Although the provisions are intended for small construction projects, existing ordinances make no such distinction, nor do the recommended provisions. Time-to-complete is incorporated in many contracts, so round-the-clock activity may be required. Incorporating a curfew is optional. Sound level, or noise disturbance, restrictions during night hours can be used as an alternative. The times  $N_1$  and  $N_2$  should be consistent with Article IX, or Provisions 7.1 and 7.2, if those provisions have time limits. Incorporating a distance criterion is difficult for both the potential offender and any NCO. To discourage excessive night construction, residential land used maximum levels are recommended for night hours,  $N_3$ . A specific exceedance allowance is permitted as shown in Table 6-5 with no limit on the level of the exceedance, since certain construction equipment can create high levels for short times (impact sounds). Non-tonal backup beepers are recommended.

Although noise barriers are possible for fixed sites near residences, the benefit derived from them can only be determined by geometric relationships. While it is possible to include a provision that requires a specific sound level reduction, it could only be complied with for a very limited number of situations. Consequently, inclusion is **not** recommended. See Appendix C.7; it permits an NCO to estimate whether noise barriers will be effective.

Limit Number	Value
$N_1$	10 pm
$N_2$	7 am
$N_3$	55 dB(A)
$N_4$	15 minutes
$N_5$	60 minutes

**Table 6-5. Recommended values for construction noise control**

## 7.7 Motor Vehicle or Motorboat Repairs or Testing

### Alternative 1

*Repairing, rebuilding, modifying, or testing any motor vehicle, motorcycle, or motorboat between the hours of ( $N_1$ ) PM and ( $N_2$ ) AM the following day.*

### Alternative 2

*Repairing, rebuilding, modifying, or testing any motor vehicle, motorcycle, or motorboat in such a manner as to cause a noise disturbance across a real property boundary in a residential zone or within a noise sensitive zone or between the hours of ( $N_1$ ) PM and ( $N_2$ ) AM the following day.*

### Definitions Needed

3.22, 3.23, 3.24, 3.29, 3.30, 3.42, 3.45

### Comments

This provision is a *subjective immission* control. Although the consequences of this activity could be incorporated into Article IX, the purpose is to educate the potential offender that the sound from this *specific* activity is not allowed (fair warning). The activities cited above when occurring at a person's home can create a serious noise disturbance for neighbors; in particular are repairs of recreational or home-built vehicles.

### Existing Provisions

Los Angeles, CA covers this noise problem in three ways. The first is application of the noise disturbance provision in residential districts between the hours of 8 pm to 8 am. The second is being audible at a distance of 150 feet or more in residential districts between the hours of 8 pm to 8 am. The third is exceeding the presumed ambient by 5 dB. See Appendix A.3.6. It also includes those within the property boundary of multi-occupancy units. Dallas, TX exempts repairs between 7 am and 10 pm. Hammond, IN prohibits noise disturbances in residential zones at any time.

### Recommended Values

This provision should be separate from the domestic tools in Provision 7.16, as the primary source here is often engine sound. The first alternative permits any levels during the day but requires a curfew during night hours. The second alternative is recommended in that the noise disturbance provision is applied at all times with a curfew applied during night hours. The times  $N_1$ , and  $N_2$  should be consistent with Article IX and Provisions 7.1 and 7.2, if those provisions have time limits.

## 7.8 Airport and Airport Operations

*(a) The NCO shall consult with the airport owner to recommend changes, that the owner may have authority to implement, in airport operations to minimize any community noise disturbance.*

*(b) Nothing in this section shall be construed to prohibit, restrict, penalize, enjoin, or in any manner, regulate the movement of aircraft which are in all respects conducted in accordance with, or pursuant to, applicable federal laws or regulations.*

## Comments

No comprehensive local *immission* or *emission* control is possible except for airport sound that is not related to flight operations, so detailed recommendations about airport noise is beyond the scope of this document. Aircraft are perhaps the most important mover of people and they require considerable energy (and therefore make considerable sound), and can result in enormous amounts of litigation. Because there is considerable federal pre-emption related to aircraft use, there are only a limited number of things a community can do to control aircraft sound. Only vague provisions above are included here. Land use planning around airports, residential sound “proofing”, and flight path restrictions are possibilities. See 4.6.1 in Chapter 4 for an exception.

The advent of jet aircraft, starting with the Boeing 707, created a very large number of complaints and legal challenges concerning the high levels of noise in surrounding residential communities. Over the years, engine manufacturers have significantly reduced the sound emission of jet aircraft by use of high bypass engines and other improvements. New and upgraded airports have located themselves outside of densely populated areas to reduce impact. The Federal Aviation Administration, and others, has developed methods to assist in identifying and reducing noise impact using such metrics as  $L_{dn}$  (Day-Night Sound Level) or CNEL (Community Noise Equivalent Level) or NEF (Noise Exposure Forecast) contours (See Appendix C.11). Noise assessment of this type can be complex both technically and legally. In smaller communities, there are local airports and airparks in which propeller aircraft operate. Although the sound power is considerably less than that for large jets there are still two problems. Propeller sound has tonal characteristics more offensive than the broadband sound of jets. Aircraft operators can be less disciplined than commercial pilots, and often fly sufficiently low to buzz residential areas.

## Existing Provisions

Chandler, AZ has an airport and an airpark. To control land use around these fields, they use  $L_{dn}$  contours to identify and control noise impact. Arizona has land use compatibility requirements for maximum Day-Night Sound Levels in various use categories. Albuquerque, NM restricts engine run ups to ambient plus 5 dB at a property line at night. They also have time and level restrictions on helicopter sound while operating on the ground. San Jose, CA imposed a curfew (11 pm to 7 am) on aircraft over 75,000 lbs and was forced to change the requirement to one that was noise based. Hawaii prohibits trick or acrobatic flying over populated areas or public gatherings. Colorado Spring, CO restricts testing and ground run-ups to 60 dB(A) at residences. Anchorage, AK ordinance (15.70.060) states:

No person shall operate aircraft engines while the aircraft is on the ground or operate an airport facility in such a manner as to cause a noise disturbance across a residential real property boundary, on a public space or within a noise-sensitive zone. The department shall consult with the airport proprietor to recommend changes in airport operations to minimize any noise disturbance that the airport owner may have authority to control in its capacity as proprietor. Nothing in this section shall be construed to prohibit, restrict, penalize, enjoin or in any manner regulate the movement of aircraft that are in all respects conducted in accordance with or pursuant to applicable federal laws or regulations, including but not limited to takeoff, landing or overflight procedures.

## 7.9 Places of Public Entertainment

### Alternative 1

*Operating, playing, or permitting the operation or playing of, any radio, television, phonograph, drum, musical instrument, sound amplifier, or similar device in any place of public entertainment which produces, reproduces, or amplifies sound in any place of public entertainment at a sound pressure level greater than (N) dB(A) at any position normally occupied by a customer, unless there is a conspicuous and legible sign located outside such place, near each public entrance, stating “WARNING: SOUND LEVELS WITHIN MAY CAUSE PERMANENT HEARING IMPAIRMENT”.*

### Alternative 2

*Operating, playing, or permitting the operation or playing of, any sound amplifying system in any place of public entertainment without the use of a compressor/limiter, or similar device, to automatically limit the sound pressure level to (N) dB(A) at any position normally occupied by a customer.*

### Definitions Needed

3.1, 3.35, 3.52

### Comments

This provision is an *objective immission* control where the distance to a listener is not specified. It is intended to control the sound received by *voluntary* participants within the perimeter of the activity. A typical application is a small restaurant or bar that may have both indoor and outdoor seating. It can be applied to small events, such as lawn parties, as well as large events. Provision 7.21 for large events is intended to protect *involuntary* listeners. The major concern of this provision is protecting the hearing of the occupants, both the customers and employees. Sound levels at customer locations often are sufficient to cause at least a temporary hearing loss (temporary threshold shift, TTS), and indications are that entertainers have some permanent hearing loss due to repetitive exposure. In one measurement, the sound level at a point 25 feet from the bandstand was a continuous 128 dB(A). Events in school gyms have been recorded at 103 dB(A). This provision includes schools that create sound for entertainment purposes. Another concern is protecting the surrounding neighbors from noise disturbance. In one case, the level *inside* a bedroom in an adjacent home was 62 dB(A) with the windows closed *after the sound passed through the brick wall of the place of entertainment*. This problem is not included in this provision, but is handled in Article IX.

The first alternative is passive in that it only makes use of a warning. It avoids enforcement within the perimeter of the activity, while Article IX can be used to enforce against sound levels exterior the perimeter. The second alternative makes use of current technology to limit the output of the sound system but it requires active enforcement. The weakness is, of course, that the user will be able to adjust, or bypass, any device used to control levels. Use of “noise disturbance” in this provision is of little help since anyone annoyed would leave the premises.



## Existing Provisions

Los Angeles, CA requires signs and limits noise exposure to 95 dB(A) at any position normally occupied (Note that the position need not be occupied). Seattle, WA considers the sound emitted to be in violation if the sound is plainly audible *within a dwelling* from 10 pm to 7am; a practical alternative since that would be the origin of a complaint and no sound measurement is needed. This was probably intended to handle commercial establishments in buildings also having residences. That specific situation is handled in Article IX or Provision 7.20 of this document. Chicago, IL limits sound levels to 55 dB(A) *inside* a residential dwelling unit but if the ambient is greater, the limit is 65 dB(A). If outdoors, the limit is “conversational level at 100 feet from the property line”. If the building is set back 20 feet from the property line, the allowable level is 84 dB(A)! Both of Chicago’s limits apply from 10 pm to 8 am. Salt Lake City, UT sets the limit at 95 dB(A) at a position that would normally be occupied by a customer and 100 dB(A) at other positions. The latter requirement presumably would apply to persons on stage. Albuquerque, NM and Anchorage, AK set maximum levels for any person at 90 dB(A). In licensing “dance halls”, Dallas, TX requires them to be at least 1000 feet from a residential zone. This requirement is more properly placed in another ordinance controlling land use. When music is played, the bass sound is often dominant, so Hawaii limits such sound to 60 dB(C) during daytime hours and 50 dB(C) at night in any land use zone. New York City limits the sound from commercial music to 45 dB(A) within any nearby residential unit. Richmond, CA prohibits noise disturbance but also sets an *emission* maximum level of 85 dB(A) at the source property line. It would take about 1600 feet to reach 55 dB(A).

Few existing ordinances address the noise impact on voluntary listeners but rather the noise impact on involuntary listeners. This provision is aimed at protecting voluntary listeners.

## Recommended Values

A classic text on the effect of noise on man (K.D. Kryter) has shown that a significant (more than 20 dB) temporary loss of hearing (TTS) occurs at levels of 95 dB(A) or more. The value of N is recommended to be between 90 and 95 dB(A).

## 7.10 Explosives, Firearms, Impulsive Sources and Similar Devices

*(a) The use or firing of explosives, firearms, or any other impulsive source between the hours of (N<sub>1</sub>) PM and (N<sub>2</sub>) AM the following day without first obtaining a special variance issued by appropriate authority, or;*

*(b) the use or firing of explosives, firearms, or any other impulsive source so as to cause a noise disturbance across a real property boundary, or in a noise sensitive zone, or in a public property, or in a right-of-way, without first obtaining a special variance issued by appropriate authority. [Such permit need not be obtained for licensed game-hunting activities on property where such activities are authorized.]*

*(c) Licensed construction activities and licensed shooting ranges are exempt from this provision.*

*(d) Unauthorized shooting ranges are prohibited.*



## Definitions Needed

3.18, 3.29, 3.30, 3.39, 3.40, 3.42

## Comments

These provisions are *immission* controls and are **not** intended for application to construction activities (See Provision 7.6) or organized shooting ranges (See Provision 7.19). *Unauthorized* shooting ranges do fall under this provision. Impulsive sounds cause startle and create a uniformly negative response in involuntary listeners. Although impulsive sound can be measured accurately with the proper sound level meter, it is only practical to make measurements for consistently repetitive sources. The degree of negative impact caused by high impulsive levels is not firmly established for levels found in a community, so objective measurements are not as valuable as hoped. This provision uses the subjective approaches of noise disturbance and curfew.

## Existing Provisions

Some communities use the Article IX provisions on maximum land use sound levels and allow a 10 dB exceedance. Portland, OR limits levels to 100 dB (Peak) from 7am to 10pm and 80 dB (Peak) at other times. For blasting they allow 98 dB(C) from 7 am to 10 pm and 93 dB(C) at other times. In both cases, it requires use of special sound level meters. Los Angeles, CA uses Table A-22 in Appendix A.3.6 as a presumed ambient and allows 5 dB more. Atlanta, GA prohibits impulsive sources, such as blasting, on weekends or holidays, and limits it to between 6 am and 6 pm on weekdays.

Source Land Use Category Below	Maximum Impulse Level, dB(A) in		
	Commercial	Residential	
		Day	Night
Residential	50	50	45
Commercial	57	56	45
Industrial	61	56	46

**Table 6-6. Illinois maximum permitted blasting sound levels**

Illinois has detailed regulations on impulsive sounds, especially blasting and impact. The rules for blasting in industrial zones that impact other zones are shown in Table 6-6. Daytime is normally 7 am to 10 pm, but they have added “sunrise to sunset” for blasting. Table 6-7 shows the maximum A-weighted impulse levels permitted. All measurements are to be made 25 feet beyond the property line of the receiving land use. Seattle, WA requires that the level must exceed the ambient by more than 10 dB. This implies restriction of enforcement to a sound level reading.

Receiving Land Use Category	Maximum Blasting Level, dB(C)	
	Day	Night
Residential	109	99
Commercial	114	104

**Table 6-7. Illinois maximum permitted impulse sound levels**

## Recommended Values

The times  $N_1$  and  $N_2$  should be consistent with Article IX or Provisions 7.1 and 7.2, if those provisions have time limits. Note that no specific impulse levels are included because

responses of listeners vary strongly based on the nature of the source; a banging door and a distant rifle discharge may generate similar levels but have much different responses.

## 7.11 Powered Model Vehicles

### Alternative 1

*Operating, or permitting the operation of any powered model airplane, boat, car, or rocket, or its engine, between the hours of ( $N_1$ ) PM and ( $N_2$ ) AM the following day.*

### Alternative 2

*Operating, or permitting the operation of powered model airplane, boat, car, or rocket, or its engine, so as to cause a noise disturbance across a real property boundary in a residential zone or in a noise sensitive zone, or is plainly audible at ( $N_3$ ) feet on public property.*

### Alternative 3

*Operating, or permitting the operation of powered model airplane, boat, car, or rocket, or its engine, outside public areas or outside times officially designated for their use.*

### Definitions Needed

3.29, 3.30, 3.36, 3.38, 3.39, 3.40, 3.42, 3.44, 3.45

### Comments

This provision is a *subjective immission* control. Alternatives 1 and 2 and apply to either public or private property, while Alternative 3 restricts use to specifically designated areas. These alternatives can be merged into one that is more inclusive. Alternative 1 permits free operation during daytime hours and applies a curfew during night hours. Alternative 2 applies the noise disturbance concept on private property and the plainly audible concept on public property. Note that “plainly audible” is primarily used for speech and music (Definition 3.36); it has been expanded here to the characteristic sound of model vehicles. Powered model aircraft are remotely controlled, come in a variety of sizes, and can be driven by propellers or jets. This section is intended to regulate model vehicles that are used primarily for recreational purposes. See Section 7.26 for unmanned aerial vehicles that are used for other purposes. Model vehicles are in widespread use. Airplanes, boats, rockets, and cars are examples. Small jet engines are now available and can be tested prior to attachment to a vehicle; small pulse jets are particularly loud. Model aircraft can overfly a residence, so can have significant noise impact. For propeller aircraft, a recommended practice in the UK would limit model levels to 86 dBA at 7 meters. This translates to 55 dBA (typical environmental limit) at about 800 feet. A US model club recommends a limit of 96 to 98 dBA at 20 feet and at an angle of 90 degrees (the direction of minimum sound from a propeller). This translates to between 55 dBA and 61 dBA at 2400 feet depending on the orientation of the aircraft to the listener. Acrobatic maneuvers cause flow separation on the blades and result in higher levels. Not all propeller powered model aircraft are this noisy, but in many cases, multiple aircraft are aloft at the same time. No information is available on the sound from model boats, pulse jet propulsion or turbojet engines.

## Existing Provisions

Salt Lake City, UT limits activity to 800 feet or more from a dwelling between 10 pm and 7 am, or if it causes a noise disturbance. Atlanta, GA uses the plainly audible criterion across a residential property line or in a noise sensitive zone, a public right-of-way or a public property on weekdays from 10 pm to 7 am or on weekends or holidays from 10 pm to 10 am. , Kenosha, WI prohibits activity between 9 pm and 7 am if it creates a noise disturbance in a noise sensitive zone, or across a residential property line, or at 100 feet from any path on public property. Hammond, IN prohibits a noise disturbance between 9 pm and 7 am at any location. There has been a number of complaints in the UK about model aircraft noise. In one case, the flight area was restricted. The Farnworth Area Model Aircraft Club (UK) aircraft were restricted to 55 dBA at 30 meters and the operation restricted to the period from 9 am to 5 pm. A guideline in the UK entitled "Noise from Model Aircraft 1982" recommended that all flights should be kept beyond 200 meters (650 feet) from noise sensitive areas and operation restricted to the period from 9 am to 7 pm.

## Recommended Values

The issue is clear from a regulatory viewpoint; model aircraft must be removed spatially from noise sensitive areas (distance restrictions) and restricted to normal waking hours (time restrictions). *Objective emission* control of model aircraft noise is essentially unenforceable, since unmanned model vehicles are moving most of the time. The plainly audible part of the recommended provisions is best applied to stationary vehicle tests. However, the area of ground vehicles may be restricted enough to make it enforceable under Article IX which can always be used as a backup to this provision. Alternative 2 is recommended. The value of  $N_3$  is recommended to be 800 feet to minimize the need to enforce Alternative 2. The times  $N_1$  and  $N_2$  need not be consistent with Article IX or Provisions 7.1 and 7.2, since authorized times should be only during daylight hours. A policy to restrict operations to authorized and clearly open areas is helpful to avoid negative neighborhood reactions. Although it is possible to include a percentage of time provision to account for the various levels created by model motion, it is best to use Article IX in that case. The subjective nature of Alternative 2 gives the NCO sufficient leeway to separate obvious disturbances from minor ones.

## 7.12 Vibration

### Alternative 1

(a) *Operating, or permitting the operation of, any device that creates vibration which is above the vibration perception threshold of any person across real property boundary in a residential zone, or in a noise sensitive zone, or in a public property.*

(b) *Vibration created by railroad vehicles used in interstate commerce is exempted.*

### Alternative 2

(a) *Operating, or permitting the operation of, any device that creates vibration which is above the vibration perception threshold of any person across a real property boundary in a residential zone, or in a noise sensitive zone, or in a public property, or between the hours of ( $N_1$ ) PM and ( $N_2$ ) AM the following day.*

(b) *Vibration created by railroad vehicles used in interstate commerce is exempted.*

### Definitions Needed

3.30, 3.40, 3.42, 3.45, 3.55, 3.56

### Comments

This provision is a *subjective immission* control, but in the form of vibration. Unacceptable vibration in communities can be caused by devices such as drop hammers, stamping machines, and railroad locomotives. The sound from locomotives used in interstate commerce is specifically exempted by federal law (40 CFR 201), but there is nothing related to vibration caused by them, so item (b) may not be necessary. There are two levels of vibration of concern. The sound from lower vibration levels subject listeners to a noise disturbance. Higher vibration levels can cause objects to move or induce failure in adjacent structures and are a safety issue as well as a disturbance issue. Since the response is essentially subjective, use of Vibration Perception Threshold (Definition 3.48) and a curfew are practical control mechanisms.

### Existing Provisions

Chicago, IL considers it a violation if the vibration is perceptible at 300 feet in a residential or commercial district. Dallas, TX limits ground vibration at the property line of industrial zones as shown in Table 6-8 (an *emission* control). The maxima are displacements in inches. Maryland uses non-technical observation as the criterion (touch sensation or observation of vibrating objects).

Frequency, Hz	I1 and I2 Zone	I3 Zone
0-10	.0010	.0020
10-20	.0008	.0016
20-30	.0005	.0010
30-40	.0004	.0006
Higher than 40	.0003	.0005

**Table 6-8. Dallas maximum permitted vibration**

### Recommended Values

Alternative 1 restricts vibration levels at all times, Alternative 2 also restricts levels, but also puts a curfew on vibration. The times  $N_1$  and  $N_2$  should be consistent with Provisions 7.1 and 7.2, if those provisions have time limits. If work creating significant vibration must be performed outside the limits, it is recommended that a temporary variance be given. Not addressed in this provision is acceptable vibration levels during permitted times. The non-technical approach of Maryland is the simplest criterion while the Dallas approach requires professional measurements.

## 7.13 Stationary Non-Emergency Non-Safety Signaling Devices

*Sounding, or permitting the sounding of, any natural or amplified signal from any stationary bell, chime, siren, whistle, speaker, or similar device, intended primarily for non-emergency or non-safety purposes from any place for more than ( $N_1$ ) minutes in any hourly period or between the hours of ( $N_2$ ) PM to ( $N_3$ ) AM the following day.*

## Definitions Needed

None

## Comments

This provision is an *emission* control intended to control the source as opposed to reducing the impact on specific listeners. Since vehicles are capable of motion, they are handled in Provision 10.7. Note that this provision is **not** intended to cover signals that can be interpreted as “speech” (See Provision 7.2).

The occasional sounding of bells from churches on Sundays or clock towers daily in the past was considered acceptable by the community. The advent of electronic amplification has enormously increased the level and distance at which the signal can be heard, reducing the acceptability of such sounds. In large communities for example, there can be a high density of churches all sounding electronically amplified bells. The most contentious issue is sound from religious facilities. Religious organizations are attempting to get all their loudspeaker signals interpreted as “speech” by interpreting it as “free expression of religion”. See litigation in 4.3.2 in Chapter 4. Curfews appear to be a reasonable restriction as is the amount of time the signals are permitted. Because of the variety of devices included herein, no sound level limit is recommended. Article IX may be applied for residential situations. Cross-walk sound signals for pedestrians are for safety and so are exempted. Note that “plainly audible” is primarily used for speech and music (Definition 3.36), and here it has been expanded to the characteristic sound of bells and chimes.

## Existing Provisions

Los Angeles, CA prohibits the sounding if the signal can be heard at 200 feet or more. Chicago, IL considers the sound to be a noise disturbance in residential areas if the sound exceeds 5 minutes in any hour; steam whistles are exempt. Madison, WI exempts church bells on Sundays and religious holidays. Albuquerque, NM restricts levels to 5 dB over the ambient at a property line and applies Article IX maximum levels, or plainly audible restrictions for a dwelling at night. Fort Collins, CO exempts church bells. Green Bay, WI exempts church bells and clocks. Milwaukee, WI exempts (church) bells and clocks between 7 am and 10 pm if the sound lasts 5 minutes or less. Houston, TX allows church bells between 7 am to 10 pm provided they ring 5 minutes or less each hour. Lakewood, CO places a curfew on church bells, clocks, and school bells during night hours and exempts them at other hours. Seattle, WA exempts clock chimes and church bells during daytime hours. Connecticut exempts signals associated with religious services and intrusion alarms to 30 minutes if attached to a building. Mobile, AL limits alarm time to 15 minutes.

## Recommended Values

The values of  $N_2$  and  $N_3$  are recommended to be consistent with Article IX, or Provisions 7.1 and 7.2, if those provisions have time limits. The permitted time should be reasonable for the sounding of clocks and church bells and the Islamic call to prayer. The value of  $N_1$  is recommended to be 5 minutes. Not included here is the restriction of clocks to chiming only once an hour. It may be necessary to enumerate in the provision those that are permitted and those that are not permitted to sound. All exemptions must be chosen carefully to insure that no unintentional bias is created. Dividing the provision into days-of-the-week may be politically necessary but may add more complexity for enforcement.

## 7.14 Stationary Emergency Signaling Devices

(a) *The intentional sounding, or permitting the sounding, outdoors of any stationary fire, burglar, or civil defense alarm, siren, whistle, or similar stationary emergency signaling device, except for emergency purposes, or for testing as provided in section (b).*

(b) (1) *Testing of a stationary emergency signal device shall occur at the same time of day each time such test is performed, but not before (N<sub>1</sub>) AM or after (N<sub>2</sub>) PM. Any such test shall use only the minimum cycle test time. In no case shall the test exceed (N<sub>3</sub>) minutes.*

(2) *Testing of the complete emergency signal system including the functioning of the signal device and the personnel response to the signaling device, shall not occur more than once each calendar month. Such testing shall not occur before (N<sub>1</sub>) AM or after (N<sub>2</sub>) PM. The test time limit specified in (1) shall not apply to such complete system testing.*

(c) *Sounding, or permitting the sounding, of any stationary exterior burglar or fire alarm unless such alarm is automatically terminated after (N<sub>4</sub>) minutes.*

### Definitions Needed

3.14

### Comments

This provision is an *emission* control and not intended to reduce the impact on specific listeners. The curfew provision on testing creates no difficulty for organizations with emergency alarms. Because of the variety of devices included herein, no sound level limits are considered necessary and only allowed periods are included.

Audible home security alarms are increasingly annoying events and time limits on their sounding is a reasonable control. Many systems have wired connections to alarm companies with no audible output. Those that do make sound alert intruders immediately, so they can estimate how much time it takes before police response. Long term sounding of a false alarm creates strong negative response in the local community, particularly in response personnel (police).

### Existing Provisions

Chicago limits tests to 4 minutes and only between 9 am to 5 pm. Oregon prohibits signaling sound when an emergency *vehicle* is stationary.

### Recommended Values

The times N<sub>1</sub> and N<sub>2</sub> can be consistent with Article IX or Provisions 7.1 and 7.2 for simplicity but most testing is done during normal working hours so the allowable time can be much shorter. The value of N<sub>3</sub> should permit adequate time to complete the test. **The value of N<sub>4</sub> is recommended to be 10 minutes**, similar to that for automobile theft alarms (Provision 10.8).

## 7.15 Noise Sensitive Zones

(a) *Creating, or permitting the creation, of any sound in a noise sensitive zone that creates a noise disturbance of occupants of the facility, provided that conspicuous signs are displayed indicating the presence of the zone.*

(b) *Helicopter operations at hospitals are exempt.*

### Definitions Needed

3.29, 3.30

### Comments

This is a *subjective immission* control. The presence of properly placed signs suggests that abnormally loud, or unusual, sounds are not permitted. The larger the list, the more difficult and selective the enforcement must be for the NCO. Definition 3.30 in Chapter 5 has an extensive discussion of the difficulties of defining and enforcing noise sensitive zones. As noted in the definition, there does not seem to be sufficient justification for this provision (except to establish enforcement priorities) if Articles IX and X are properly written.

## 7.16 Domestic/Commercial Power Tools

### Alternative 1

*Operating, or permitting the operation of, any mechanically powered saw, drill, sander, grinder, lawn or garden tool, snow blower, leaf blower, or similar device used outdoors in residential zones between the hours of (N<sub>1</sub>) PM and (N<sub>2</sub>) AM the following day.*

### Alternative 2

*Operating, or permitting the operation of, any mechanically powered saw, drill, sander, grinder, lawn or garden tool, snow blower, leaf blower, or similar device used outdoors in residential zones so as to cause noise disturbance across a real property boundary or between the hours of (N<sub>1</sub>) PM and (N<sub>2</sub>) AM the following day.*

### Definitions Needed

3.29, 3.42, 3.45

### Comments

This provision is a *subjective immission* control. Sound created in residential zones, or propagated into residential zones, is normally handled by Article IX that limits the maximum sound crossing property boundaries. Some domestic power tools can be operated at any location within a boundary (e.g., lawn mowers) and so the property boundary in Article IX may not be a fair measurement location. It is reasonable to have a curfew as well as a subjective disturbance limit during non-curfew hours. An *objective emission* limit may run into pre-emption problems. The sound level of some domestic products may be specified by the federal government, in which case no sound level limits can be specified for them in a local ordinance. Another problem with *emission* limits is that the community would have to make tests or get certifications for each product type by each manufacturer.



## Existing Provisions

Portland, OR limits levels created by *indoor* tool use to less than 80 dB(A) at the source property line from 7 am to 10 pm and a curfew thereafter. Outdoor tools of 5 horsepower or less are limited in the same way. For tools of more than 5 horsepower the limit is 85 dB(A). They also have a unique way of handling leaf blowers. The NCO is required to make a list of products that do not exceed 65 dB(A) at 50 feet and a list of products that do not exceed 70 dB(A) at 50 feet. If the leaf blower is not on the list, the product is in violation, or must be tested. Los Angeles, CA provides an extensive and categorized list of equipment and maximum sound level limits for them in Los Angeles Municipal Code, Chapter IX, Section 112.05. Chicago, IL also provides a similar list. Madison, WI limits levels to 70 dB(A) at 50 feet for tools less than 5 hp and 78 dB(A) for tools 5 to 20 hp. Albuquerque, NM restricts the location to be 500 feet from any residential or noise sensitive zone at night and between 7 am and 9 pm on Sundays and holidays, but exempts power mowers on golf courses. Fort Collins, CO limits residential property line levels to 85 dB(A) between 7 am and 8 pm and applies the land use maximum levels at other times. Dallas, TX exempts lawn maintenance between 7 am and 10 pm. Green Bay, WI exempts snow removal machines. Milwaukee, WI exempts home tools, such as lawn mowers, during the hours between 8 am to 9 pm. Illinois exempts lawnmowers statewide between 7 am and 10 pm. Houston, TX restricts levels at residential property lines to 85 dB(A) from 7 am to 8 pm and restricts levels to land use levels, 58 dB(A), at other times. Maryland exempts domestic tools during daytime hours. Boulder County, CO exempts power tools of less than 5 hp between 7 am and 10 pm. Charlotte, NC prohibits activity less than 300 feet from residences between 9 pm and 7 am. Hammond, IN prohibits a noise disturbance between 9 pm and 7 am at any location. New Jersey separates residential use from commercial use in residential zones. Residential use is exempt from 8 am to 8 pm and land use regulations apply at other times. Commercial use is exempt from 8 am to 6 pm on weekdays and from 9 am to 6 pm on weekends and land use regulations apply at other times. {NOff} describes the potential health effects of gas-powered landscaping equipment, such as mowers, trimmers, and hedgers. The site discusses the promoters of them, some legal aspects, and recommends alternatives. Leaf blowers are of concern to numerous states and communities. {NFA} has 26 articles about the problem of leaf blowers in particular. Hawaii prohibits blower operation in residential zones or within 100 feet of a residential zone during certain days and hours of the day (§342F-30.8). Connecticut exempts lawn care equipment between the hours of 7 a.m. and 9 p.m. and snow removal equipment provided it is “adequately muffled”. Massachusetts exempts lawn mowers and power saws between the hours of 7 am and 8 pm. Colorado Springs, CO exempts domestic equipment levels in all zones if the sound level is 80 dB(A) or less at 25 feet or at the receiver’s property line during daytime hours. For commercial equipment the limit is 88 dB(A). Presumably, the Article IX levels apply at other times. Hartford, CT exempts domestic power equipment from 7 am to 9 pm on weekdays provided the “exhaust is adequately muffled”. The same applies to snow removal equipment. Louisville, KY exempts lawn mowers between 7 am and 9 pm. New Orleans, LA exempts power tools, lawn movers between 7 am and 10 pm on weekdays and 8 am and 10 pm on weekends and then limits their sound level to 75 dB(A) at 50 feet of 5 H.P. or less and 82 dB(A) if more than 5 H.P.



### **Recommended Values**

The large number of communities with provisions of this type suggests that domestic tool sounds are an environmental noise problem. The addition of emission limits should be studied carefully prior to adding them. The times  $N_1$  and  $N_2$  should be consistent with Article IX or Provisions 7.1 and 7.2.

## **7.17 Air Conditioning, Heating, or Pool Equipment**

*The operating, or permitting the operation, of any air conditioning, or heating system, or any pool mechanical equipment outdoors so as to cause noise disturbance across a real property boundary in a residential zone or at a condominium, apartment, duplex, or similar unit within the real property boundary .*

### **Definitions Needed**

3.29, 3.42, 3.45

### **Comments**

This provision is a *subjective immission* control and is generally used in warmer climates. It supplements the provisions of Article IX where it may be difficult to apply that article. Although federal noise regulations may apply to some equipment so that the equipment sound output may not be required to be reduced, it is always possible to require barriers or enclosures. A curfew is not an option, since the equipment may be necessary at all times.

### **Existing Provisions**

Los Angeles, CA limits the level to 5 dB over the values in Table A-12 in Appendix A.3.6 and specifically adds more impacted persons, such as neighbors within the same property, such as condominiums, apartments, or duplexes. This aspect also is handled in Provision 7.20. Green Bay, WI exempts *properly maintained* air conditioners (discriminatory enforcement may be possible). Houston, TX restricts air conditioning equipment levels to 65 dB(A) when measured at 15 feet (60 dB(A) at 50 feet) between 7 am and 8 pm. In Commercial and Industrial zones, the permitted level is 75 dB(A) at 15 feet. Maryland limits air conditioning sound levels to 70 dB(A) and heat pump levels to 75 dB(A) at residential property lines. Albuquerque, NM prohibits the installation of noise making mechanical equipment on commercial property when one side of the property is adjacent to noise-sensitive property (residences included).

### **Recommended Values**

The recommended provision is subjective, giving the enforcement official some room for judgment. Objective provisions, such as those cited in existing provisions, are *emission* controls in that each specific item of equipment would have to meet a standard. Due to the varieties of equipment and the variety of distances to a potential listener, it would become a project for the NCO to define such standards. A curfew is **not** practical and none is recommended.

## 7.18 Tampering

(a) *The removal or rendering inoperative by any person other than for the purpose of maintenance, repair, or replacement, of any noise control device, or element of design, or noise label of any product, or;*

(b) *the modification or replacement of any noise control device that increases the sound pressure level of the device.*

(c) *At every point of sale where a noise control system for a motor vehicle, motorcycle, airboat, motorboat, snowmobile, or off-road vehicle is offered for sale or sold including, but not limited to, a new or used dealership, part store, muffler shop, or other local retail outlet, a conspicuous, large, and clearly legible sign with high contrast bold lettering shall be posted stating:*

**WARNING: ANY NOISE CONTROL SYSTEMS, INCLUDING MUFFLERS AND EXHAUST SYSTEMS THAT DO NOT MEET THE ORIGINAL SPECIFICATIONS OF THE SYSTEM INSTALLED BY THE MANUFACTURER MAY BE IN VIOLATION OF FEDERAL, STATE, OR LOCAL LAW AND ARE SUBJECT TO PENALTIES.**

### Definitions Needed

3.22, 3.23, 3.24, 3.25, 3.32, 3.34, 3.52

### Comments

This provision is an *emission* control and is intended to control the source by preventing increases in sound output. Note that “any person” applies not only to the owner but also to any muffler shop, and its employees. It permits a community to *prevent* noise impacts by enforcing the federal anti-tampering law (e.g., 40 CFR 205 for motorcycles). As the federal government expands the anti-tampering law to more products, this provision may permit the community to enforce any new federal regulations. The words “may permit” is added because preemption can extend to “....where enforcement might frustrate federal purposes”. Two important examples are the removal of mufflers on motorcycles, and the removal of mufflers on trucks using dynamic engine brakes.

### Existing Provisions

Most states and many communities have anti-tampering laws and ordinances related to mufflers, such as parts (a) and (b). Part (c) is a direct copy of the Salt Lake County Noise Ordinance (Section 4.5.10 iii).

### Recommended Values

The first two parts are corrective while part (c) is mostly preventive. All three parts are strongly recommended.

## 7.19 Authorized Outdoor Discharge of Firearms (Shooting Ranges)

(a) *The use or firing of firearms, or any other sound creating weapon, between the hours of (N<sub>1</sub>) PM and (N<sub>2</sub>) AM the following day on weekdays, and between the hours of (N<sub>3</sub>) PM and (N<sub>4</sub>)*

*AM the following day on weekends, and without first obtaining a special variance issued by appropriate authority.*

*(b) The expansion of an outdoor shooting range without a public hearing.*

## **Definitions Needed**

3.47, 3.57

## **Comments**

This is a curfew provision only. Note that “other weapon” can include the sound from rocket projectiles, but excludes such weapons as arrows. Organized firearm use comes in two varieties related to noise. The first are indoor and outdoor shooting ranges where the target is at ground level. They can be for military, police, or recreational use. Military and police shooting ranges are generally exempted from a community noise ordinance although sound output is always of concern to range managers. In large urban areas, only shooting ranges for officials exist and they are almost always indoors, creating no community noise problem. In states with more open space, open ranges exist and noise disturbance can result. The US Constitution permits gun ownership by the general public (Amendment II), so there are many recreational ranges. Aside from the fact that a regulated militia is no longer necessary (now the National Guard) and the purpose of a gun is to destroy something, the National Rifle Association defends that right, making it difficult to eliminate shooting ranges. They have been instrumental in getting most states to have a “Shooting Range Protection Act” that exempts existing ranges from prosecution caused by noise disturbance. New residences moving into a noise impacted area would have no legal protection (the “we were here first” argument). In most cases, the prohibition does not apply when substantial changes to the range are made provided action to quiet is initiated within a limited time period.

The second variety of range is for skeet shooting (clay pigeon) where a target object is catapulted into the air. They are mainly for recreational use. The difference is that the shot is directed upward suggesting a larger range area.

Weapons on shooting ranges are limited to guns that are, by their nature, impulsive sources of sound. Provision 7.10 is intended for application in primarily residential areas by mostly single impulsive sources which includes guns, while a shooting range has guns that have numerous and frequent discharges in a specific area set aside for such activity. It is a fundamentally different enforcement problem.

The noise problem has been exacerbated by the advent of large caliber and assault weapons in the hands of recreational shooters. Levels at the shooters ear can range above 150 dB. Hearing damage to the shooter can result from frequent gun use, even with ear protection. Although most recreational shooters are members of the local community, it is beyond the authority of a noise ordinance to protect their hearing. Some impulsive sound data at *ten meters* is shown in the Table 6-9 for the purpose of calculating impact on the local community.

Weapon	dB(A)
Shotgun	127
Rifle	126
Automatic	128
Pistol	126

***Table 6-9. Sound levels of small arms***

## Existing Provisions

South Carolina (Title 31, Chapter 18) requires that signs be placed on primary roads up to one mile from the range to state “SHOOTING RANGE-NOISE AREA”. Arizona shooting range law puts a 10 p.m. to 7 a.m. curfew on all ranges. It requires the Energy Equivalent Sound Level ( $L_{eq}$ ) (Appendix C.11.1) measured over one hour to be 64 dB(A), or less, at 20 feet (presumably toward the source) from the noise impact point (generally a residence). The law requires that any new development within one mile of an existing range must provide for “noise buffers”. The buffers must be such that the law requirements are met. The law applies for any residence or other noise sensitive facility within one mile of the range. This method of measurement requires more than an ordinary sound level meter, and the specific procedure does not capture peak levels of the impulsive sound (FAST, not impulse, response is required), resulting in lower measured levels. A number of studies cited in a Royal Canadian Mounted Police document “Shooting Ranges and Sound” recommend that from 5 to 12 dB should be added to the measured A-weighted level to account for the startle effect of impulsive sound. The Arizona law allows for a tradeoff between the number of events and the sound output of the weapons. For example, firing a 105 mm howitzer once an hour is permissible under this law. For weapons such as those in the Table 6-9, reducing the frequency of use from 100% to 10% permits guns to be 10 dB louder. Using the law, a simple calculation was made for a worst case condition with one shot (125 dB at 30 feet) in each minute of an hour. The influence of terrain plays a role in the resultant distance at which the Arizona law is acceptable and the distance at which most community noise ordinances set for residential zones. The results in Table 6-10 make it clear that the sound from frequent firing of the weapons normally found at ranges can extend to very long distances. This is a worst case, but at competitions that amount of activity can occur. Land use planning is an obvious issue for planning departments and can be a headache for an NCO. It is clear that a shooting range with surrounding open hard ground and shooting directed toward residences is not a good situation. With soft ground and the shooting direction not facing residential areas, the distances are practical. The approximate calculations above make it very clear that a shooting range must have a lot of land around it and that land should **not** be converted to residences.

Range Condition	Flat, hard, ground, facing	Soft, grass, ground, facing	Soft, grass, ground, 90 degrees	Soft, grass, ground, 180 Degrees
Distance to $L_{eq}=64$ dB(A)	7.1 miles	2100 feet	600 feet	260 feet
Distance to $L_{eq}=55$ dB(A)	Not practical	1.1 miles	1800 feet	750 feet

**Table 6-10. Approximate propagation distance of small arms sound**

Alaska, New Hampshire, Missouri, and many other states specifically exempt shooting ranges. Some give exemptions if the range existed prior to the establishment of the complainant’s residence; others give a total exemption. New Hampshire goes one step further with Section 159-B.6 of Title XII.

**Exemption from State Standards.** – No standard in rules adopted by any state agency for limiting levels of noise in terms of decibel level, which may occur in the outdoor atmosphere, shall apply to the shooting ranges exempted from liability under the provisions of this chapter.

Colorado declares that *noise restrictions* on shooting ranges "work to the detriment of the public health, welfare, and morale"! Some states limit the time for complaints to five years from the establishment of the shooting range for residences established prior to the range establishment. Seattle, WA exempts shooting ranges under all conditions. Connecticut normally exempts shooting ranges except local communities can have control of expansion activities. Arizona and Idaho require new developments near a shooting range take noise mitigation steps as part of the approval process, or fund such steps at the shooting range. Florida restricts control of ranges to the Department of Environmental Protection. Nebraska permits communities to have a curfew from 10 pm to 7 am, while Wisconsin sets the time limits at 11 pm to 6 am. New Mexico prohibits local communities from regulating the location and construction of sport shooting ranges. New York state limits the sound level to 90 dB(A) at 100 feet beyond range property line for one hour or not to exceed 85 dB(A) for eight hours at the same position. It prohibits operation between 10 pm and 7 am unless local law permits it.

During the day atmospheric conditions can be favorable for the range because sound tends to curve upward, but can be unfavorable because wind is generally higher during the day and if residences are downwind, the sound curves downward so the sound levels are higher. At night, atmospheric conditions can be unfavorable for the range because sound tends to curve downward due to temperature differences. Also, the sensitivity of people to sound is heightened at night.

### **Comments on Good Neighbor Policies**

The second amendment to the US Constitution is sometimes stretched beyond reasonable bounds by irresponsible shooters. As a result, negative public attitudes can develop that place restrictions on responsible shooters. Open air shooting ranges are no exception. There are a number of range policies (if not in state or local law) that can reduce friction with local communities:

- Permit operating hours only from later in the morning to early in the evening. Certainly the hours must be during daylight. Consider different hours for weekends from weekdays.
- Restrict operating hours when high winds are blowing toward residential areas.
- Prohibit automatic weapons and rifles of .50 caliber or larger.
- Encourage community officials to restrict development adjacent to the range. See the comments below.
- If possible, direct all shooting away from residences to reduce sound impact.
- Construct berms to reduce the possibility of stray bullets reaching the community.
- Provide fencing totally around the site, with warning signs sufficiently close together that a person attempting to cross the fence could not miss seeing the sign.
- Convince community officials to erect street signs (if not in the ordinance) warning of possible noise impact.

### **Comments on Siting**

Opposition to shooting ranges comes mostly from nearby residents (See 4.6.5 and 4.6.6 of Chapter 4). In Prescott, AZ, residential property actually abuts the range property line with the nearest home being 175 feet from a shooting position. How did the homes get there if the range was already in existence? Ranges bring little income to the local government, but residential development does, so any valuable land near a range is likely to be developed despite

the opposition of the National Rifle Association or state statutes protecting the right of shooting ranges to exist. The best method of protecting the health and welfare goals of the community is to properly site new, or moved, ranges to minimize noise impact and then control adjacent land use. A number of conditions, in addition to distance, can be required during site location approval:

- Propagation over water or hard ground should be avoided (6 dB higher for a two-fold increase of noise impact distance).
- Flat surfaces should be grassed (adds a loss of up to 25 dB to the normal distance loss).
- Tall berms should be constructed in the direction of residences (adds a loss up to 16 dB).
- If possible, a hill should be between the site and residences (similar or greater loss than a berm).
- The direction of shooting should point away from residences (adds a loss of 18 dB at 180 degrees, and 10 dB at 90 degrees).
- Add barriers behind and to the side of shooters (adds a loss of about 12 dB), but there are increased levels for the shooter.
- Activity should be during the day. (Atmospheric heating bends sound upward away from the ground).

### **Comments on Silencers**

Silencers provide a technical solution to hearing loss of the shooter and community noise impact. Federal law (18 USC 921) defines them:

The terms “firearm silencer” and “firearm muffler” mean any device for silencing, muffling, or diminishing the report of a portable firearm, including any combination of parts, designed or redesigned, and intended for use in assembling or fabricating a firearm silencer or firearm muffler, and any part intended only for use in such assembly or fabrication.

Many states permit silencers on guns and there are companies that sell such devices. However, ownership is very tightly regulated by the Bureau of Alcohol, Tobacco, and Firearms. For identification purposes a silencer is considered to be a weapon. Local registration is also required. No information is available on any loss of accuracy caused by the presence of a silencer or whether any shooting ranges make use of silencers, such as rental of weapons equipped with them.

### **Recommended Values**

A public hearing is recommended when changes to a range are contemplated.

Curfews at night are reasonable controls. The times  $N_1$  and  $N_2$  need not be consistent with Article IX or Provisions 7.1 and 7.2. The times should be restricted to late morning to early evening when it is light and local residents are more accepting of noise. Weekends are when range use is more probable. The start time  $N_3$  is a judgment call. Residents arise later, but shooters may wish to get an early start. The end time  $N_4$  should be at the earliest time of the year that twilight occurs.

## 7.20 Condominiums and Apartments

### Alternative 1

*The making, continuing, or causing to be made or continued, any noise disturbance, or plainly audible sound, in another occupied space within any condominium, apartment, duplex, or similar unit within the real property boundary.*

### Alternative 2

*The making, continuing, or causing to be made or continued, any noise disturbance, or plainly audible sound, in another occupied space within any condominium, apartment, duplex, or similar unit within the real property boundary; or between the hours of (N<sub>1</sub>) PM and (N<sub>2</sub>) AM the following day.*

### Definitions Needed

3.29, 3.36, 3.42

### Comments

This provision is a *subjective immission* control. Although most of a noise ordinance is addressed to environmental (exterior) sound sources, particularly the sound that crosses property lines, complaints often concern sound within multi-use property. Examples are neighbors who play loud music (especially the thump, thump of bass), or have parties, in a multi-use building. Another source of annoyance is the activity sounds created by persons on the floor above, particularly impact sounds of feet. Although the activity creates building vibration, that vibration converts to sound in the lower floor and so is contained in the above provision as opposed to the vibration provision. The noise disturbance is sometimes even greater than that from exterior sound sources. Enforcement of objective standards is difficult (See 7.20 in Chapter 7), so only a subjective provision is included here. Curfews are a possible alternative.

### Existing Provisions

Salt Lake City, UT considers it a noise disturbance if it raises the interior ambient by 5 dB between 7 am and 10 pm and by 3 dB at other times. Minneapolis, MN considers it a violation if the indoor level increases 10 dB between 6 am and 10 pm or increases 5 dB between 10 pm and 6 am. Albuquerque, NM restricts levels to 5 dB above ambient or at nighttime to be plainly audible within the dwelling unit. Fort Collins, CO applies the maximum land use (exterior) sound levels for indoors. Omaha, NE requires that the sound be “not audible”.

Charlotte, NC limits dwelling unit levels to 55 dB (A) between 9 am and 9 pm and 50 dB (A) at other times. New Jersey has more specific requirements: they have a maximum level in each

Octave Band Frequency	7 am to 10 pm	10 pm to 7 am
31.5	96	86
63	82	71
125	74	61
250	67	53
500	63	48
1000	60	45
2000	57	42
4000	55	40
8000	53	38
A	67	54

**Table 6-11. New Jersey maximum octave band sound levels**



octave band as shown in Table 6-11. This applies to any source, either exterior or interior. Burlington, VT restricts sound that is plainly audible between 10 pm and 7 am. Hammond, IN restricts levels to plainly audible. In Burlington, VT property owners of rental housing are required by ordinance to furnish a copy of the city ordinance to tenants at the beginning of the rental term.

Defining ambient levels in a dwelling may be difficult. The offended party may wish to be talking or listening to a radio or TV; is that the ambient? Applying exterior maximum sound levels [e.g., 55 dB (A)] indoors does not create acceptable levels for a living space. See discussion of speech interference in Appendix C.6.

### **Recommended Values**

Because of the variety of possible noise intrusions, the variability of the ambient, an objective provision such as those listed above may not be sufficient to solve the disturbance problem although it may solve the NCO's problem. The ambient-plus provisions, the exterior maximum levels, as well as the octave band requirements cited above create additional complexity for the NCO and are **not** recommended. Consequently, **a subjective provision is recommended.** "Clearly audible" is included since many of the intrusions are music or speech sounds. The times  $N_1$  and  $N_2$  should be consistent with Article IX or Provisions 7.1 and 7.2.

## **7.21 Stadiums and Outdoor Music Festivals**

### **Alternative 1**

*The operating, or permitting the operation, of any sound system in a stadium, arena, or similar outdoor location, that creates a noise disturbance across a real property boundary in a residential zone, or in a noise sensitive zone.*

### **Alternative 2**

*The operating, or permitting the operation, of any sound system in a stadium, arena, or similar outdoor location, that creates a noise disturbance across a real property boundary in a residential zone, or in a noise sensitive zone, or is in operation after ( $N_1$ ) PM.*

### **Alternative 3**

*The operating, or permitting the operation, of any sound system in a stadium, arena, or similar outdoor location, that creates a sound pressure level more than ( $N_2$ ) dB(A) across a real property boundary in a residential zone, or in a noise sensitive zone, or is in operation after ( $N_1$ ) PM.*

### **Definitions Needed**

3.1, 3.29, 3.30, 3.42, 3.45, 3.52

### **Comments**

This provision is either an *objective or subjective immission* control. Music festivals not only generate extremely high levels in the audience due to the large number of speakers and power amplifiers, but also may generate a lot of revenue for the jurisdiction in which the event occurs. Consequently, permits are readily available. The hearing damage to the audience is voluntary, but levels in surrounding residences can be sufficient to violate all reasonable noise



ordinances. Worse, the high levels generally persist for the entire performance. The first alternative is subjective and permits operation at any hour as long as no noise disturbance occurs. The second alternative is also subjective but places a curfew on operations and limits sound output during permitted hours to that which does not create a noise disturbance. That alternative is based on the assumption that the event will be loud and difficult to enforce so an absolute time limit is added. The third alternative is objective and places a sound level limit as well as a curfew. The only reason for Alternative 3 is to allow the maximum sound level to be different from that in Article IX. Note that nothing is stated in these provisions about a permit. Normally that requirement is found in other ordinances. This provision was not intended to regulate events such as parades but may be applied to street fairs. If exemptions to the provision are considered, they should be carefully chosen to avoid the “discriminatory” challenge. See 4.3.2 of Chapter 4.

### **Existing Provisions**

Illinois (Environmental Protection Act 415.25) exempts certain stadiums from their noise ordinance, and exempts festivals, parades, or street fair, if conducted with a permit. Columbus OH requires that a permit be issued for such events. Colorado Springs, CO exempts festivals and associated activities if the maximum sound level during daytime does not exceed 80 dB(A) at residential locations. Presumably, the land use limits apply at other times.

### **Recommended Values**

It is reasonable to set a value for  $N_1$  as an ending time, particularly for night events when sleep interference can occur. It also gives the involuntary listeners hope that the noise impact will be finite in time. Setting a value for  $N_2$  is more difficult. The sound attenuation from events in open fields or on local streets is considerably less than that from large stadiums. So it may not be an appropriate balance to require the same maximum levels as those in Article IX. The noise impact is generally on residential zones, so the location of the event plays an important role in choosing that level. It is recommended that sound level limits be placed on these kinds of events when permits are issued to give the NCO some guidance about what is considered reasonable.

## **7.22 Funerals**

*No person may engage in loud singing, playing of music, chanting, whistling, yelling, or the making of any other sound with, or without, any sound amplification equipment, including, but not limited to, bullhorns, auto horns, and microphones within 200 feet of any ingress or egress of an active funeral site, where the level of such sound is plainly audible to attendees at the site.*

### **Comments**

There are certain groups, particularly those that object to involvement in foreign wars, who believe it is an obligation to disrupt and picket funerals, especially those of deceased military veterans. The intent of this provision is to avoid the distasteful disruption of such services without impinging on the Constitutional right of free speech.

### **Definitions Needed**

3.36

## Existing Provisions

Several states have such provisions. Illinois has a comprehensive provision (720 ILCS 5/26-6) covering more aspects of this event than noise. They failed to use “plainly audible” which is narrower than “audible”. Utah also has a similar statute. It is recommended that this provision not be included in the noise ordinance but in the ordinance that covers all aspects of funeral disruption.

## 7.23 Wind Turbines

*No person shall perform site planning for wind turbine farms without setting desired maximum sound pressure levels at the real property boundary of existing residential zones.*

### Definitions Needed

3.34, 3.42, 3.45, 3.52

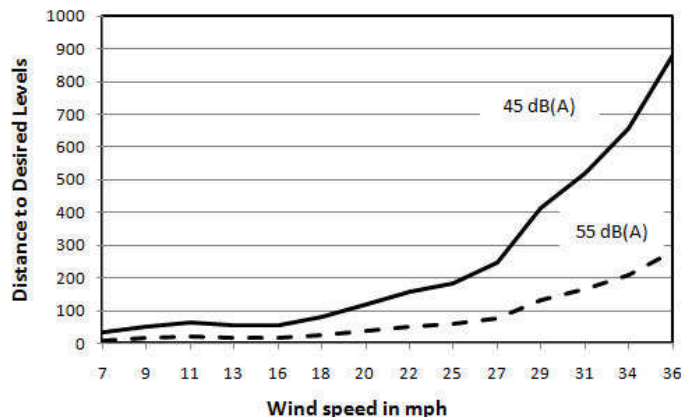
### Comments

Most wind turbines are relatively large and the blades rotate slowly. Not all are in that category as private use of smaller ones is increasing. Because of the low rotation rate of the blades, many believe that the sound emission is small and at low frequency. Measurements by the National Renewal Energy Laboratory showed that the sound frequencies are well into the range where they can be heard. They estimated the sound power of a number of wind turbines from sound level measurements. As expected, the power increased with wind speed. These data were converted to the distance in feet required to achieve two environmental levels: 55 dB(A), a typical maximum daytime level found in many noise ordinances and 45 dB(A) for strict nighttime levels. The results are shown in Figure 6-2 for a representative turbine based on inverse square spreading (no barriers, no wind or temperature gradients). It is clear that the required distance is determined by the wind speed, so planning should be determined based on estimated maximum wind speeds in the local community. This example was not one of the louder turbines; the worst case was a turbine measured at 29 mph. The distance to reach 45 dB(A) was about 3000 feet.

## Existing Provisions

Illinois has a program to install wind turbines. They had this to say in a report on wind energy:

Another issue that is brought up in trying to stop the development of wind projects is that wind turbines are noisy. Wind energy proponents claim that an operating modern wind farm at a distance of 750 to 1,000 feet is no noisier than a **kitchen refrigerator** or a moderately quiet room. Industry studies estimate wind turbine noise levels



*Figure 6-2. Approximate distance to achieve environmental levels from a typical wind turbine.*

to be around **45 decibels**.

**The data strongly suggest that wind turbines and refrigerators are not equal in sound output!** The state did acknowledge that two situations can occur where wind farms can be louder. The first situation is when older turbines are in operation. Older turbines from the 1980's tended to be louder. The other situation occurs in hilly terrain with modern turbines. Homes located in sheltered dips or hollows downwind from a wind farm could experience a noisier environment due to noise carrying further. The second situation can often be anticipated and avoided in the development process through adequate setbacks. New Hampshire sets a sound level limit at the *site* property line at 55 dB (A-weighting presumed), **not** at the receiving property line. Presumably it applies at any wind speed.

### **Recommended Values**

Wind turbine farms will increase in number and the noise impact from them must be considered. The number of units, their spatial distribution, unit size, and maximum wind speed all play a role in that impact. Obtaining noise data and creating a perimeter around the farm that identifies the distance at which the desired environmental sound levels are achieved is necessary. Because land acquisition can be expensive, setting environment levels the same as those recommended in Article IX may not be realistic.

## **7.24 Propane Cannons**

### **Alternative 1**

*No person shall operate propane cannons or similar sound generating devices to scare birds, animals, or attempt to alter weather, which creates a noise disturbance across a real property boundary in a residential zone, or in a noise sensitive zone; or between the hours of (N<sub>1</sub>) PM and (N<sub>2</sub>) AM the following day and the hours of (N<sub>3</sub>) AM and (N<sub>4</sub>) PM.*

### **Alternative 2**

*No person shall operate propane cannons or similar sound generating devices to scare birds, animals, or attempt to alter weather, with (N<sub>5</sub>) impulses per hour ,within (N<sub>6</sub>) feet of any real property boundary in a residential zone, or noise sensitive zone.*

### **Alternative 3**

*No person shall operate propane cannons or similar sound generating devices to scare birds, animals, or attempt to alter weather, at any time.*

### **Definitions Needed**

3.18, 3.29, 3.30, 3.34, 3.42, 3.45

### **Comments**

Alternative 1 is a *subjective immission* control with a curfew. Alternative 2 is a performance limitation based on how often shots are fired; Alternative 3 is a prohibition.

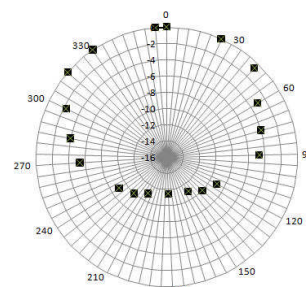
Farms that raise cherries, blueberries and grapes are subject to predation by a variety of bird species during growing season. A common method of chasing these birds is to use propane powered explosions in a short tube to create sufficient sound to frighten them away. Figure 6-3 shows a common propane cannon. Because of habituation, these explosions have to occur

repeatedly at short time periods from less than a minute to several minutes. Propane cannons are also used to frighten animals such as deer, and have been used in an attempt to prevent hail in southern climates. Propane cannon use has been increasing in recent years. There are a number of manufacturers of cannons and their sound levels at one meter from the cannon are between 120 and 130 dB(A) when measured at 90 degrees from the cannon axis. Figure 6-4 shows the approximate directivity pattern for such a device. It should be noted that the level along the axis is about 5 dB louder than the level at 90 degrees and 11 dB louder than the level behind the cannon.

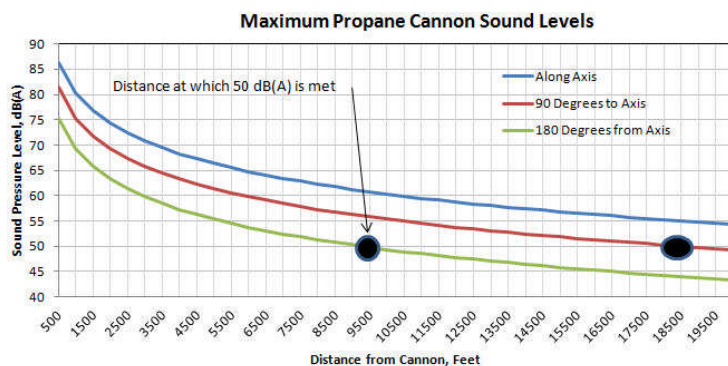


**Figure 6-3 Propane cannon.**

There are two ways to evaluate the impact of these devices, depending on the type of provision in the ordinance. Many land use ordinance have maximum allowed levels near 55 dB(A) during daylight hours with a 5 dB reduction if the character of the sound is impulsive (Appendix A). Propane sound levels can be estimated over a flat, open surface. The distances to meet such a strict provision are shown in Figure 6-5 and Table 6-12. The distances are prohibitively large for such a restrictive ordinance and could only be met in extremely rural areas. The actual distance would be less if terrain features and vegetation were to intervene. However, distances also can



**Figure 6-4.**  
*Approximate directivity  
pattern of a propane  
cannon.*



**Figure 6-5. Distances to meet 50 dB(A) sound limits.**

Angle	Distance
180 Degrees	1.8 miles
90 Degrees	3.5 miles
Along Axis	More than 5 miles

increase due to temperature and

**Table 6-12. Distance to meet 50  
dB(A) limit for  
propane cannon sound.**

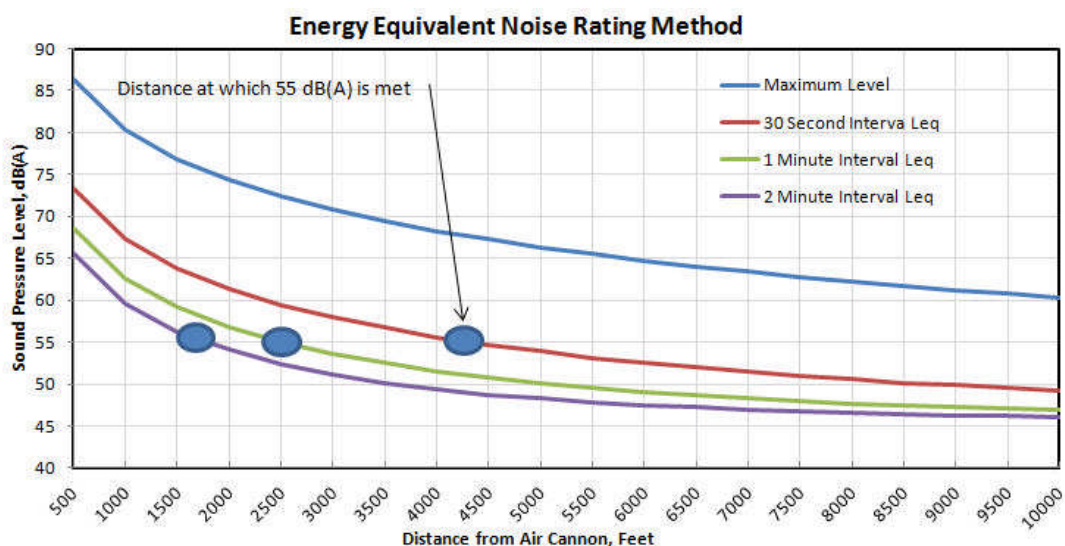
wind caused refraction. Cannon orientation plays a large role in noise impact on nearby residents.

Another type of ordinance provision uses the  $L_{eg}$  method (Appendix C.2.5) to determine impact. Rather than look at the maximum level, this method accounts for the impact based on the average sound energy reaching the listener over a period of time, typically one hour. Figure 6-6 and Table 6-13 shows the distances to reach  $L_e=55$  dB(A); (no limit reduction for the impulsive nature of the cannon sound). The number of shots per hour

plays a large role in the noise impact on nearby residents. The upper row is the repetition rate recommended by the British Columbia Ministry of Agriculture. Even with these reduced distances, the noise impact area can be extensive particularly if more than one cannon is used.

Angle	Shots/Hour/Cannon			
	180	60	30	12
180 Degrees	1200	750	500	250
90 Degrees	2500	1500	1000	750
Along Axis	4000	2500	2000	1200

**Table 6-13. Distance in feet to meet  $L_{eq}=55$  dB(A) for propane cannon sound.**



**Figure 6-6. Distance in feet to meet  $L_{eq}=55$  dB(A) for propane cannon sound.**

### Existing Provisions

In many states there is a Right to Farm Act intended to protect farms from attempts to limit activities by residents in nearby encroaching residential areas. This makes it difficult to regulate cannon sound. One example is Florida (FS 823.14) which states:

"...that agricultural activities conducted on farm land in urbanizing areas are potentially subject to lawsuits based on the theory of nuisance and that these suits encourage and even force the premature removal of the farm land from agricultural use. It is the purpose of this act to protect reasonable agricultural activities conducted on farm land from nuisance suits."

Section 4 of the Florida law states:

- a. "No farm operation which has been in operation for one year or more since its established date of operation and which was not a nuisance at the time of its established date of operation shall be a public or private nuisance if the farm operation conforms to generally accepted agricultural and management practices;"
- b. "No farm operation shall become a public or private nuisance as a

result of a change in ownership, a change in the type of farm product being produced, a change in conditions in or around the locality of the farm, or a change brought about to comply with Best Management Practices adopted by local, state, or federal agencies if such farm has been in operation for one year or more since its established date of operation and if it was not a nuisance at the time of its established date."

Section 5 of the Florida law states:

"This act shall not be construed to permit an existing farm operation to change to a more excessive farm operation with regard to **noise**, odor, dust, or fumes where the existing farm operation is adjacent to an established homestead or business on March 15, 1982."

Note that section 5 can be interpreted to prevent cannon use if such use commenced after the residential areas existed. Changing to a crop which needs cannon protection may also be interpreted as an "excessive" use.

To address this type of law some states have developed statutes related to this issue. Virginia code (§ 15.2-918) states:

"Locality may prohibit or regulate use of air cannons.

Any locality may by ordinance prohibit or regulate the use within its jurisdiction of certain devices, including air cannons, carbide cannons, or other loud explosive devices which are designed to produce high intensity sound percussions for the purpose of repelling birds. Such ordinance may prescribe the degree of sound or the decibel level produced by the cannon or device which is unacceptable in that jurisdiction. In adopting an ordinance pursuant to the provisions of this section, the governing body may provide that any person who violates the provisions of such ordinance shall be guilty of a Class 3 misdemeanor."

A number of Virginia counties have used this statute to limit cannon use. They use the regulation of impulsive sources as opposed to an air cannon specific provision, likely to avoid the argument that such law is directed specifically against farmers. For example, Fairfax County can use the land use maximum levels (105-4-4) or loud and unnecessary noise (108-5-1) provisions to limit cannon use.

The British Columbia Ministry of Agriculture, Food, and Rural Affairs stated that birds usually feed early in the morning around sunrise and late in the afternoon around sunset. If this is generally the case, it would seem that the impact could be reduced by limiting the number of shots to specific hourly periods with an additional curfew from the evening to early morning.

Some of the Ministry rules on cannon use are:

- Operation of devices only between 6:30 am and 8:00 pm.
- no operation between noon and 3:00 pm.
- one device on each five acres of blueberries.
- relocate the devices every 4 days.
- use other scare tactics and not just noise devices.
- fire each cannon only once every five minutes.
- cannon no closer than 200 meters from a home.
- point devices away from residential areas.
- no more than 11 activations or maximum of 33 shots in any hour for a multiple-shot device.



Some of the recommendations to avoid cannon use listed in a *banthecannons.com* site. are: Totally enclosing nets, side nets, automatic net systems, lasers, repellents, streamers, sacrificial planting, human field activity, scare windmills, canine patrols, metal and mirrored flashers, and mylar vibrating strips.

### Recommended Values

Alternative 1 is general protection for listeners and is complaint based. The data presented above suggest that it is not likely that cannons can be operated in close proximity to residences without complaint, but the provision does allow use, if no complaints are filed. It has no distance requirement, so enforcement may be subject to constitutional vagueness (arbitrary enforcement) arguments. It includes a curfew at hours when bird

predation is unlikely as recommended in Table 6-14.

Alternative 2 permits cannon use but places distance restrictions based on the frequency of shots. The recommended distances are shown in Table 6-15 and are based on the louder cannon direction facing a residential area. Multiple cannons use would tend toward this distance even although all would not be facing a residential area.

Alternative 3 eliminates cannon use and is recommended when the fields are adjacent to residential areas as the distances (such as those shown in Table 6-15).are too small to provide health and welfare protection to listeners.

Item	Time
N <sub>1</sub>	Sunrise
N <sub>2</sub>	Sunset
N <sub>3</sub>	12 pm
N <sub>4</sub>	3 pm

**Table 6-14. Curfew hours for propane cannon use**

Impulses per hour, N <sub>5</sub>	Minimum Distance, Feet, N <sub>6</sub>
12	1200
30	2000
60	2500
180	4000

**Table 6-15. Distance limitations for propane cannon use**

## 7.25 Fracking Operations

*Several other provisions of this chapter are needed depending state of the operation. See Recommended Values section below*

### Definitions Needed

Use definitions applicable to state of fracking operation as discussed in Recommended Values below.

### Comments

Fracking is an operation to recover oil and gas from strata deep below ground. It requires the drilling of a hole which at a chosen depth is redirected to nearly horizontal. When the hole is completed, fluid, typically water based, is put into a porous pipe under extremely high pressure, fracturing the surrounding strata making the desired resource available for recovery. Within the fluid are quantities of



**Figure 6-7. View of a fracking field.**

sand which is driven into the cracked rock to hold it open. The flow in the pipe is then reversed and the desired material is removed. Within the US there are numerous areas under which the resources that can be recovered with fracking; many are in farm or other rural areas. Figure 6-4 shows a fracking operation field. The spatial limitations of each fracking operation may require numerous wells in a producing area to make significant recovery. Each well may require more than one operation to maximize return. There are numerous objections to fracking operations, noise being but one. For example, over two million gallons of water may be used per well each fracking operation, requiring about 360 tanker trucks to carry it. Over one million gallons are recovered as toxic industrial waste to be carried away.

### **.Existing Provisions**

A number of communities, such as Buffalo, NY, have banned fracking. Others regulate the areas in which fracking can be done; while others require permits. A Colorado court case upheld the right of a community to control noise emissions, at fracking sites, provided the ordinance is no stricter than state law.

### **Recommended Values**

Numerous court cases have shown that outright bans by communities are not allowed; but noise issues have not been central in those cases, leaving a community the right to regulate sound output from fracking sites that does not conflict with state law. Initial activity at a fracking site is similar to a construction site and may be regulated as such (Provision 7.6). Federal law limits the sound from construction equipment under 40CFR204. Portable air compressor noise is governed by federal regulation 40CFR204 (76 dB(A) at 50 feet). Once in operation, on site truck traffic and compressors are the major noise sources. Article IX may be used to regulate that sound. Off-site truck traffic noise is subject to Article X (Provisions 10.1 and 10.6). Truck noise emission is governed by federal regulations; 40CFR202 (86 dB(A) at 50 feet on a highway less than 35 mph and 90 dB(A) over 35mph) and 440CFR205 (medium and heavy trucks: 80 dB(A) at 50 feet).

## **7.26 Unmanned Aircraft Systems (Drones)**

### **Alternative 1**

*Operating, or permitting the operation of any unmanned aircraft system between the hours of (N<sub>1</sub>) PM and (N<sub>2</sub>) AM the following day is prohibited.*

### **Alternative 2**

*Operating, or permitting the operation of any unmanned aircraft system so as to cause a noise disturbance within or across a real property boundary in a residential zone or in a noise sensitive zone, or is plainly audible at (N<sub>3</sub>) feet on public property is prohibited.*

### **Definitions Needed**

3.29, 3.30, 3.36, 3.38, 3.39, 3.40, 3.42, 3.44, 3.45

### **Comments**

Unlike model aircraft used primarily for recreational purposes (Provision 7.11), unmanned aircraft systems, commonly called drones, can be used for a variety of purposes: public, commercial, or private. One common application is for surveillance. Public uses are



associated with police or other government agencies; private surveillance applications are increasing. The number of other applications for drones is expanding rapidly and it is predicted that drones will be ubiquitous in the near future. There are three types of drones from a noise viewpoint; (1) aircraft powered by propellers (there is no evidence that jets are being used on them); (2) hovercraft with multiple vertically oriented propellers or small helicopters; or (3) extremely small devices that use wing flapping as a bird would. The second type is of primary concern with respect to noise. The notable advance associated with these vehicles is the use of GPS technology. GPS controlled aircraft can fly precisely at any altitude unlike usual model aircraft. GPS controlled hovercraft can do the same but can remain at a fixed position for extended periods of time. Presently, most hovercraft drones are small; their sound is very similar to that of model aircraft. A number of them have four propellers adding 6 dB of sound to single propeller versions. Unlike most other noise ordinance provisions which relate to ground based noise sources, the impact here is from a noise source above ground and at essentially any altitude. For example, the Shadowhawk drone helicopter has a rotor over six feet in diameter and is used by police for surveillance; the noise impact of such a drone at an altitude of 400 feet or less would violate any reasonable noise ordinance. Another aspect of drones is identification of the operator. Unlike most other noise sources, the drone can be controlled remotely by a person not necessarily visible to the listener.

### **Existing Provisions**

The Federal Aviation Administration has responsibility for all altitudes above ground. The FAA recommends that model aircraft fly below 400 feet. One rule prohibits the FAA from promulgating “any rule or regulation regarding a model aircraft, or an aircraft being developed as a model aircraft, if the following statutory requirements are met:

- the aircraft is flown strictly for hobby or recreational use and is in line-of-sight of the operator;
- the aircraft is operated in accordance with a community-based set of safety guidelines and within the programming of a nationwide community-based organization;
- the aircraft is limited to not more than 55 pounds unless otherwise certified through a design, construction, inspection, flight test, and operational safety program administered by a community-based organization;
- the aircraft is operated in a manner that does not interfere with and gives way to any manned aircraft; and
- when flown within 5 miles of an airport, the operator of the aircraft provides the airport operator and the airport air traffic control tower with prior notice of the operation.

Flights associated with business (exchange of cash for services) would not be considered as hobby or recreational flights. Unmanned aircraft are included in the definition. The drone being in line-of-sight of the operator does not necessarily imply that the operator can be observed by the listener.

The right to privacy in the Fourth amendment of the US Constitution may help to control the noise impact of drones. Opposition to domestic drone use is focused on privacy concerns, not noise. The National Park Service has banned drone use within their properties. A number of communities have passed restrictions on drone use within city limits. Some have prohibited their

use entirely, others prohibit the addition of weapons to them, and others require warrants for their use. In every case, the restriction was not for noise but for privacy from surveillance.

### Recommended Values

Although this document pertains exclusively to sound, the surveillance capabilities of drones, privacy concerns add a powerful motive enacting a provision. The FAA rules noted above, give a community the authority to regulate drone use and thus its noise, provided the conditions are met. The noise from almost all nearby drones is well over the limits of any reasonable noise ordinance. Because of the unwue nature of drones, several methods may be required. Although designed for ground based noise sources, Article IX, "Sound Levels by Receiving Land Use", may be used as *objective immission* controls at receiving properties. Based on sound data available for model aircraft, drones within 800 feet of a property boundary would violate the limits of a reasonable noise ordinance (See Appendix A). Since drones are moving vehicles, Article X, "Motor Vehicle Sound Levels", may be used as *objective emission* controls by requiring registration and testing of the drones.

Item	Item
N <sub>1</sub>	7 pm
N <sub>2</sub>	7 am
N <sub>3</sub>	800 Feet

**Table 6-16.**  
**Recommended limits**  
**for drones**

## Article VIII EXCEPTIONS AND VARIANCE

### 8.1 Emergency Exception

*The provisions of this ordinance shall not apply to the emission of sound for the purpose of alerting persons to the existence of an emergency, or to the emission of sound in the performance of emergency work. Nothing in this section shall be construed to permit law enforcement, ambulance, fire, or other emergency personnel to make sound beyond that absolutely necessary in the performance of their duties.*

### Definitions Needed

3.14, 3.15, 3.34, 3.48

### Comments

Exemptions for sound made by emergency vehicles or emergency work are standard in most noise ordinances. Emergency vehicles typically use both flashing lights as well as sirens, to alert those with either vision or hearing problems. The limitation of lights is that the eye is directional so they can be missed if not looked at, while the ear is omnidirectional. Sirens are not completely effective in traffic when persons in their automobiles have earphones, listen to high levels of music, or own vehicles with high sound attenuation from outside sound. Thus sound signals are necessary to alert nearby persons to the presence of an emergency vehicle, but inattentive or distracted persons may not be alerted. For years the older siren was used; it was loud and steady in level. Some American and European sirens have a lower level and make use of an unusual sound to alert listener. Since most modern vehicles have sound systems, it will, in the future, be possible to activate the vehicle device to provide an interior warning.

The temptation for new personnel in emergency vehicles to use the siren for all travel is great, resulting in unnecessary use. Stationary police vehicles need only use flashing lights. The

return trip of fire engines or empty ambulances does not constitute an emergency and sirens should not be used. Measurements of siren sound is sufficiently loud to cause a temporary threshold shift in the hearing of the onboard personnel, leading to long term permanent hearing loss and possible litigation. See further discussion in Provision 10.7.

## 8.2 Special Variances

*(a) The (NCO/Special Board) shall have the authority, consistent with this section, to grant special variance which may be requested.*

*(b) Any person seeking a special variance pursuant to this section shall file an application with the (NCO/Special Board). The application shall contain information which demonstrates that bringing the source of sound or activity for which the special variance is sought into compliance with this ordinance would constitute an unreasonable hardship on the applicant, on the community, or on other persons. Notice of an application for a special variance shall be published according to (jurisdictional procedure). Any person who claims to be adversely affected by allowance of the special variance may file a statement with the (NCO/Special Board) containing any information to support his claim. If the (NCO/Special Board) finds that a sufficient controversy exists regarding an application, a public hearing may be held.*

*(c) In determining` whether to grant or deny the application, the (NCO/Special Board) shall balance the hardship to the applicant, the community, and other persons of not granting the special variance against the adverse impact on the health and welfare of persons affected, the adverse impact on the property affected, and or any other adverse impacts of granting the special variance. Applicants for a special variance and persons contesting a special variance may be required to submit any information the (NCO/Special Board) may reasonably require. In granting or denying an application the (NCO/Special Board) shall place on public file a copy of the decision and the reasons for denying or granting the special variance.*

*(d) A special variance shall be granted by notice to the applicant containing all necessary conditions, including a time limit on the permitted activity. The special variance shall not become effective until all conditions are agreed to by the applicant. Non compliance with any condition of the special variance shall terminate it and subject the person holding it to those provisions of this ordinance regulating the source of sound or activity for which the special variance was granted.*

*(e) Application for extension of time limits specified in a special variance or for modification of other substantial conditions shall be treated like an application for an initial special variance under subsection (b).*

*(f) The (NCO/Special Board) may issue guidelines approved by (appropriate authority) defining the procedures to be followed in applying for a special variance and the criteria to be considered in deciding whether to grant a special variance.*

### Comments

This provision adds noise as a factor in granting special variances. The above text is a sample of the factors that need to be included, but the exact wording is determined by local procedures. Specific exemptions should be in the noise ordinance for those activities that should have a permanent variance. To be granted a special variance under this ordinance, the applicant must show that compliance with the ordinance would constitute an unreasonable hardship. The (NCO/Special Board) must balance the hardship to the applicant, the community, or other persons, by not granting the variance against the adverse impact on the health and welfare of the persons affected by the noise, the adverse impact on the property affected, and other adverse impacts of granting the variance. The (NCO/Special Board) may impose conditions which the applicant must satisfy before a variance is granted.

### **Existing Provisions**

Almost all ordinances have provisions of this type that are applicable to the locality, so an extensive listing of them is not warranted. Albuquerque, NM requires a public hearing before a Hearing Officer to determine whether an undue economic burden would occur on any lawful business, occupation, or activity and whether the granting would not result in a condition injurious to health or safety. Atlanta, GA requires submission to the Commissioner of Public Works for additional time to comply or that the sound shall be of temporary duration. They limit the duration to 15 days with the possibility of renewal.

## **8.3 Variance for Time to Comply**

*(a) Within (N) days following the effective date of this ordinance, the owner of any commercial or industrial source of sound may apply to the (NCO/Special Board) for a variance for time to comply with Provisions 7.12 (vibration) or Article IX. The (NCO/Special Board) shall have the authority, consistent with this section, to grant a variance not to exceed (N) days from the effective date of this ordinance.*

*(b) Any person seeking a variance for time to comply shall file an application with the (NCO/Special Board). The application shall contain information which demonstrates that bringing the source of sound or activity for which the variance is sought into compliance with this ordinance prior to the date requested in the application would constitute an unreasonable hardship to the applicant, or to the community, or to other persons. Notice of an application for a variance for time to comply shall be published according to (jurisdictional procedure). Any person who claims to be adversely affected by granting of the variance for time to comply may file a statement with the (NCO/Special Board) containing all information to support the claim. If the (NCO/Special Board) finds that sufficient controversy exists regarding an application, a public hearing may be held.*

*(c) In determining whether to grant or deny the application, the (NCO/Special Board) shall balance the hardship on the applicant, on the community, or on other persons of not granting the variance for time to comply against the adverse impact on the health and welfare of the persons affected, the adverse impact on property affected, and any other adverse impacts of granting the variance. Applicants for variances for time to comply and persons contesting a variance may be required to submit any information the (NCO/Special Board) may reasonably require. In*

*granting or denying an application, the (NCO/Special Board) shall place on public file a copy of the decision and the reasons for denying or granting the variance for time to comply.*

*(d) The variance for time to comply shall be granted to the applicant containing all necessary conditions, including a schedule for achieving compliance. The variance for time to comply shall not become effective until all conditions are agreed to by the applicant. Noncompliance with any condition of the variance shall terminate the variance and subject the person holding it to those provisions of the ordinance for which the variance was granted.*

*(e) Application for extension of the time limits specified in a variance for time to comply or for modifications to the initial variance under subsection (b), except that the (NCO/Special Board) must find that the need for the extension or modification clearly outweighs any adverse impacts of the granting the extension or modification.*

*(f) The (NCO/Special Board) may issue guidelines approved by (appropriate authority) defining the procedures to be followed in applying for a variance for time to comply and the criteria to be considered in deciding whether to grant a variance.*

### **Comments**

A permit is permission to conduct an activity while a variance is permission to violate the law and be temporarily secure from prosecution. A number of industrial activities adjacent to residential zones can be in violation upon initiation of a noise ordinance. The value of the provision is that it permits the owner of the facility in violation time to do what is necessary to reduce their sound output. Examples are modification of business times, the erection of barriers, the addition of mufflers or enclosures on outdoor equipment. Albuquerque, NM limits variances to one year.

### **Recommended Values**

No recommendation for the value of N is given; it must be based on local procedures.

## **8.4 Appeals**

*Appeals of adverse decisions of the (NCO/Special Board) shall be made to the (appropriate court of law). Review of the court shall be limited to whether the decision is supported by substantial evidence as specified by the appropriate authority.*

## **Article IX SOUND LEVELS BY RECEIVING LAND USE**

With the advent of jet aircraft and passage of the Noise Control Act in 1972, there was considerable study of the noise impact on land exposed to excessive noise. Much of the work related to the impact was overall in nature. For example, the impact of airport generated sound on the surrounding community and the impact of increased road traffic on nearby neighborhoods resulted in high bypass jet engines and highway barriers. Many objective metrics were developed to handle these situations. Examples are the Day/Night Sound Level ( $L_{dn}$ ), the Community Noise Equivalent level (CNEL), and others (Appendix C.11). They were designed to define the noise problems of an entire community, primarily for land use planning. They had

to be implemented by active monitoring. This article is directed at enforcement against the impact of *specific* sound sources, so these metrics are **not** incorporated in Article IX.

Provisions like those of 9.1 below can be found in so many states and communities, that the Existing Provisions section has been expanded and placed in Appendix A. That appendix should be read prior to going further.

Because there are a number of alternatives shown in 9.1, a person desiring to write a provision might be confused by too many choices. A separate Comments section can be found for each of the alternatives, weighing the advantages and disadvantages of each. The choice must depend not only on the types of noise problems encountered and the resources available, but also the type of sound level meter employed since it is an *objective* provision. Although the alternatives are listed separately below, the last alternative is a merger of them to handle a wider diversity of problems. The Recommended Values section provides further help.

## 9.1 Maximum Permissible Sound Pressure Levels

### Alternative 1

*No person shall operate, or permit to be operated, on private property any source of sound in such a manner as to create a sound pressure level which exceeds the limits set forth for the receiving land use category in Table 6-17 which may be measured at or within the real property boundary of the receiving land use.*

### Alternative 2

*No person shall operate, or permit to be operated, on private property any source of sound in such a manner as to create a sound pressure level which exceeds the limits set forth for the receiving land use category in Table 6-17 for more than ( $N_7$ ) minutes in ( $N_8$ ) minutes which may be measured at or within the real property boundary of the receiving land use.*

### Alternative 3

*No person shall operate, or permit to be operated, on private property any source of sound in such a manner as to create an Equivalent A-Weighted Sound Level that exceeds the limits set forth for the receiving land use category in Table 6-17 which may be measured at or within the real property boundary of the receiving land use.*

### Alternative 4

*No person shall operate, or permit to be operated, on private property any source of sound in such a manner as to create a sound pressure level that exceeds the ambient sound level by ( $N_9$ ) dB which may be measured at or within the real property boundary of the receiving land use.*

### Alternative 5

*No person shall operate, or permit to be operated, on private property any source of sound in such a manner as to create a tenth percentile sound level that exceeds the ninetieth percentile level by ( $N_{10}$ ) dB when measured at or within the real property boundary of the receiving land use.*



**Alternative 6**

*No person shall operate, or permit to be operated, on private property any source of sound in such a manner as to create a sound pressure level that exceeds the limits set forth in Table 6-18 for any octave band which may be measured at or within the real property boundary of the receiving land use.*

**Alternative 7**

*No person shall operate, or permit to be operated, on private property any source of sound in such a manner as to create a sound pressure level that exceeds the limits set forth in Table 6-19 for any octave band by more than (N<sub>11</sub>) dB when the A-weighted Level is measured at or within the real property boundary of the receiving land use.*

**Merged Alternative**

*No person shall operate, or permit to be operated, on private property any source of sound in such a manner as to create:*

*(a) a sound pressure level that exceeds the limits set forth for the receiving land use category in Table 6-17 which may be measured at or within the real property boundary of the receiving land use, or;*

*(b) a sound pressure level that exceeds the limits set forth for the receiving land use category in Table 6-17 for more than (N<sub>7</sub>) minutes in (N<sub>8</sub>) minutes which may be measured at or within the real property boundary of the receiving land use, or;*

*(c) an Equivalent A-Weighted Sound Level that exceeds the limits set forth for the receiving land use category in Table 6-17 which may be measured at or within the real property boundary of the receiving land use, or;*

*(d) a sound level that exceeds the ambient sound level by (N<sub>9</sub>) dB which may be measured at or within the real property boundary of the receiving land use.*

Receiving Land Use Category	Time of Day	Maximum Permissible Sound Pressure Level L <sub>a</sub>
Residential [public property, open space, agricultural, institutional]	(A) am to (B) pm	(N <sub>1</sub> )
	(B) pm to (A) am the following day	(N <sub>2</sub> )
Commercial [business]	(A) am to (B) pm	(N <sub>3</sub> )
	(B) pm to (A) am the following day	(N <sub>4</sub> )
Industrial [light, heavy]	(A) am to (B) pm	(N <sub>5</sub> )
	(B) pm to (A) am the following day	(N <sub>6</sub> )

**Table 6-17. Maximum sound levels and time-of-day categories for land use**



Octave Band Frequency	7 am to 10 pm	10 pm to 7 am
31.5	87	82
63	72	67
125	62	57
250	54	49
500	49	44
1000	46	41
2000	43	38
4000	41	36
8000	39	34
A	<b>55</b>	<b>50</b>

**Table 6-18. Maximum octave band sound levels for land use**

A	35	40	45	50	55	60	65	70	75
31.5	53	58	63	68	73	78	83	88	93
63	48	53	58	63	68	73	78	83	88
125	43	48	53	58	63	68	73	78	83
250	38	43	48	53	58	63	68	73	78
500	33	38	43	48	53	58	63	68	73
1000	28	33	38	43	48	53	58	63	68
2000	23	28	33	38	43	48	53	58	63
4000	18	23	28	33	38	43	48	53	58

**Table 6-19. Octave band sound levels for A-weighted measurements**

### Definitions Needed

3.1, 3.2, 3.6, 3.16, 3.18, 3.26, 3.31, 3.39, 3.40, 3.42, 3.45, 3.52, 3.54

### Comments on the Alternatives

This provision is an *objective immission* control. It is one of the central features for enforcement on *stationary* sound sources. The word “stationary” does not imply unmovable (an air conditioner), but it can also be a moveable sound source that is constrained to a reasonably small fixed area (lawn mower). The value of an objective provision is that it removes *discriminatory enforcement* by officials and provides *fair warning* to potential violators. Article X is a comparable provision that addresses *moving* sound sources. Both sets of provisions require the use of a sound level meter. The alternatives noted above reflect the various ways enforcement can be accomplished. The provisions of Article VII can be used in preference to this article to address specifically identified noise problems. If the numbers in Table 6-17 are

chosen to be similar to those in existing ordinances based on health and welfare concerns, the provision becomes very defensible and difficult to argue against. See Appendix A. The provisions have to address two potential technical defenses against prosecution. The first is the contribution of the existing ambient to any measurement made: What is the actual contribution of the source of interest? The second is the percent of time a violation might have occurred: How often does the limit have to be exceeded to be in violation? The requirements and implications of each alternative are given below. Appendix C.6 discusses estimating sound levels by speech interference when a sound level meter is not readily available.

#### *Alternative 1*

This is the most restrictive *fixed level* provision. If *at any time* the sound level exceeds the levels in Table 6-17, the sound source is in violation (provided that the event can be attributed to the source of interest). There are a number of problems with such a strict provision. Is the potential violator the major contributor to the measured level? If the limit is set fairly low, the ambient can be a significant contributor to the measured level so the identified source may actually be in compliance. If the ambient is well above the limit, the entire environment is essentially in violation, and any identifiable source has to be well above the ambient to be measured. Is just one event over the limit sufficient to warrant prosecution? This provision is readily defensible if the source is on continuously and is clearly audible (meaning it is well above the ambient and can be pointed at by listening with eyes closed). It is defensible if several short term events occur with levels at least 20 dB above the legal limit. For other situations, the other provisions are preferable. The advantage of this provision is that measurements can be made quickly with a simple sound level meter.

#### *Alternative 2*

This *fixed level* provision takes into account that most sound sources vary in output and permits the levels to exceed the fixed limit for a certain number of minutes out of a fixed time period (generally an hour). Since the ambient also varies with time, the difficulties noted for Alternative 1 apply here. If the source is readily identifiable and is on continuously, only a short term measurement is needed. If the source is variable, a large number of level samples are needed to determine the time of exceedance. Since it is impractical for the person monitoring to manually record levels second by second, typical enforcement with a simple meter requires a subjective “estimate” of the time. There are meters which can store the data automatically. The data have to be downloaded to a spreadsheet and the percentage of time the level has been exceeded must be manually calculated. More complex meters can collect and process the data and download the results to a spreadsheet. Sources that cycle periodically are good candidates for this alternative. This provision has to be enforced carefully to exclude transient events, such as a local horn beep.

#### *Alternative 3*

This *fixed level* provision also takes into account that most sound sources vary in output and permits the levels to exceed the limit as long as the “energy average” does not. It has been called the  $L_{eq}$  method (Appendix C.11.1). Again, ambient interference can be a problem. The measurements require a more sophisticated meter which automatically takes into account the level changes. Instead of having to collect level samples manually, as in the previous alternative, the meter continually sums the energy of the samples (the higher levels contribute more) and

time averages the data to yield a number representing the sound level that would have existed if the source did not change in level over the measurement period. This is a significant improvement over Alternative 2 but requires a better meter. It is a realistic method of accommodating sound level changes and a good tool for enforcement of stationary sources that are well above the ambient.

#### *Alternative 4*

This *relative level* provision takes into account the potential interference of the ambient by requiring that the source be limited to a certain level *above* the ambient. It has been called the “ambient-plus” method. It has the virtue that a listener’s disturbance is always relative to the existing ambient. It has the disadvantage of requiring two sets of measurements and control of the potential violator’s sound source. If the source is one that cannot be turned off, this method is valueless unless other means of determining the ambient can be found (see 9.1 in Chapter 7). The best means for both measurements is with the  $L_{eq}$  method noted in Alternative 3.

#### *Alternative 5*

This *relative level* provision also takes into account the potential interference of the ambient sound by requiring that the source be limited to a certain level *above* the ambient. Unlike Alternative 4 however, ambient is defined statistically (See the second definition of Ambient Sound Level in Chapter 5). The intruding level is also defined statistically (See the definition of Tenth Percentile Sound Level in Chapter 5). Although the meter calculates the difference between the higher level (source) and the ambient automatically, it is valueless for sources that are constant and well over the ambient in level since the two numbers are the same. In addition, this alternative requires a meter which can calculate percentile levels.

#### *Alternative 6*

This *fixed level* provision takes into account the frequency spectrum of the sound source.

The level in each octave band must be measured. An example of the requirements for Chicago, IL is given in Table 6-20; *nine* levels must be measured instead of one. Table 6-18 above shows the spectrum that may be more relevant to residential areas. This provision requires an octave band sound level meter. The same difficulties noted in the other fixed level alternatives are multiplied by nine for this method. The method of alternatives 1, 2, or 3 must be applied to each band. If any band exceeds the limit at *any* time, the source is in violation. That is probably why

Octave Band Frequency	7 am to 10 pm	10 pm to 7 am
31.5	96	86
63	82	71
125	74	61
250	67	53
500	63	48
1000	60	45
2000	57	42
4000	55	40
8000	53	38
A	<b>67</b>	<b>54</b>

**Table 6-20. Chicago maximum octave band sound levels**

Chicago has set the limits shown in Table 6-20 considerably higher than those shown in Table 6-18. It is impractical to apply a percent-of-time exceedance limit for each octave band. A sophisticated meter may be able to determine the  $L_{eq}$  for each of the octave bands. The most

likely use of this alternative is with large industrial facilities which have a constant level well over the ambient. This alternative requires considerably more effort by the NCO.

#### *Alternative 7*

This is a modified *relative level* provision that takes into account the frequency spectrum of the sound source relative to the measured ambient. It is most applicable to ambient levels that exceed the maximum levels in Table 6-17. It is a compromise in that if the ambient is already above the maximum levels, then at least the source should be one with a frequency spectrum that is somewhat acceptable. See Appendices C.3 and C.4. The A-weighted level is measured along with the octave bands. The proper octave band spectrum is chosen using Table 6-19 from the measured A-weighted level. Each measured octave band must meet the requirements of the provision.

#### *Merged Alternative*

The alternatives above address the several ways property line noise impacts can be handled, depending on ambient levels, variability of sound source levels, and meter availability. This merged alternative is designed to cover a wider range of applications that an NCO might encounter, so that several methods of enforcement can be applied depending on the situation. See the Recommended Values section below for a fuller discussion.

#### **Comments on Setting Level Limits in Table 6-17**

Many communities have set sound level limits in their ordinances. Extensive data are provided in Appendix A with discussion of the ordinances of several states and communities. These should be used as guidance for defensible values.

#### **Comments on Time Limits in Table 6-17**

In residential zones, acceptance of sound diminishes with the onset of evening and night hours, requiring that maximum sound levels be reduced. Commercial areas are sometimes intermixed with residential areas and noise reductions for them are necessary. Examples of time limits in ordinances are given in Table A-1 of Appendix A and should be used as a guideline for setting time limits.

#### **Comments on Enforcement Methods**

All of the alternatives require use of a sound level meter, but meter capabilities and cost will vary with the provision chosen. Training in meter use is not complicated, but it is recommended for the more complex meters as confidence in NCO performance by judges is strengthened. Methods of enforcement are in the relevant sections of Chapter 7.

## Summary

The array of provisions listed above can be confusing since there are several factors determining the most desirable one. Table 6-21 helps to classify these provisions in a more direct way. The merged alternative is discussed in the Recommended Values section.

Alternative Number	Level Limit	Allows Limit Exceedance	Must Separate Ambient	Best Source Output
1	Fixed	No	Yes	Constant
2	Fixed	Yes	Yes	Variable
3	Fixed	Yes	Yes	Variable
4	Relative	No	Yes	Either
5	Relative	No	Yes/No	Either
6	Fixed	No	Yes	Constant
7	Relative	Yes	No	Constant

*Table 6-21. Summary of Provision 9.1 options*

## Recommended Values

A meter that can measure  $L_{eq}$  is strongly recommended. It will also have A and C weighting, Slow and Fast response. The capability to store, and retrieve data as well as transfer data to a computer should be examined carefully.

It is recommended that the levels and time limits placed in Table 6-17 be consistent with those in other communities who have established a legal precedent for those levels; they are shown in Table 6-22. Some communities define maximum levels based on a matrix of source and receiver category; this complexity should be examined carefully, but for most communities it is **not** recommended. Some communities apply nighttime level restrictions on sound received by commercial and industrial zones; this complexity should be examined carefully, but for most communities it is **not** recommended. The purpose of night time restrictions is to permit persons in residences to be free of distractions and to be able to sleep during those hours. This is not normally applicable to commercial and industrial zones, so it is not likely that complaints will occur in those areas. To handle residences in commercial zones the definition of residential zone should include that case.

Value	Number dB(A)
A	7 am
B	10 pm
N <sub>1</sub>	55
N <sub>2</sub>	50
N <sub>3</sub>	65
N <sub>4</sub>	65
N <sub>5</sub>	75
N <sub>6</sub>	75
N <sub>7</sub>	15 minutes
N <sub>8</sub>	60 minutes
N <sub>9</sub>	5
N <sub>10</sub>	5
N <sub>11</sub>	5 dB

*Table 6-22. Recommended values for Provision 9.1*

The most important recommended values are the time limits and the maximum levels in residential zones. Since sources can vary in level, and the ambient can interfere, **the Merged Alternative is recommended**. It avoids the complexity of octave bands and does not make use of statistical levels. In conjunction with the corrections in Provision 9.2, it appears to handle most community stationary noise impacts. Since it have several parts, the preferred application of each part is summarized in Table 6-23. If the source level is separable from the ambient and is constant in level, section (a) is the best approach. If

the source is intermittent and separable from the ambient, section (b) is the best approach. If the source is highly variable and separable from the ambient, section (c) is the best approach. When the ambient interferes strongly, section (d) must be used. How the measurements are made for this provision and how “separable” is achieved, is deferred until Chapter 7.

Provision Section	Level Limit Type	Exceedance Allowed	Ambient Interference	Best used for Source Type
a	Fixed	No	Separable	Constant
b	Fixed	Yes	Separable	Intermittent
c	Fixed	Yes	Separable	Highly variable
d	Relative	Yes	Not separable	High ambient

**Table 6-23. Best use of Merged Alternative sections**

## 9.2 Corrections for Character of Sound

*For any source of sound emitting a continuous pure tone, or cyclically varying sound, or repetitive impulsive sound, the maximum sound pressure level set forth in Provision 9.1 shall be reduced by (N) dB.*

### Definitions Needed

3.8, 3.9, 3.18, 3.41, 3.52

### Comments

Greater annoyance is attached to the character of the sound when the spectrum and time history differs greatly from more constant and random sound sources, so a reduction in the maximum limits is warranted. The difficulty is in defining them defensibly. For pure tones, the addition of “continuous” exempts short term tones such as whistles. Subjective evaluation of the existence of a pure tone is generally acceptable, but objective evaluation requires a real time analyzer with octave band capability. The presence of cyclically varying sound can be evaluated subjectively, and objective evaluation must be based on the maximum level. Impulsive sounds are more difficult to evaluate subjectively. There is a difference between the impulse from a gun and that from a large drop hammer and a cyclically varying sound having a sharp onset. Objective measurement requires a meter with an impulse response capability.

If there is likely to be legal objections to these corrections, a meter with octave band capability must be purchased.

### Existing Provisions

Most communities reduce the maximum levels of Article IX by 5 dB for both pure tones and impulsive sounds. Impulsive sounds can also be addressed with Provision 7.10. Massachusetts defines a pure tone as a level that is more than 3 dB higher in an octave band than one in adjacent octave bands. Illinois defines tones in one-third octave bands and requires the band to be at least 10 dB above adjacent bands. Real time analyzers are needed. In many situations a pure tone can be determined by simply listening (subjective). There are several ways

to avoid use of a meter. There is generally little dispute if the source is a whistle, or musical instrument.

### **Recommended Values**

The value of (N) is recommended to be 5 dB. It is the same as found in many noise ordinances. It is recommended that the sound be recorded for presentation to a court if dispute is likely.

## **9.3 Exemptions**

*The provisions of Article IX shall not apply to:*

*(a) activities covered by Article VII;*

*(b) the unamplified human voice;*

*(c) railroad locomotive and cars use in interstate commerce;*

*(d) [non-stationary farm equipment/ all agricultural activities]*

### **Comments**

Exemptions must be chosen carefully. A person prosecuted for a particular noise violation may cite that the source exempted creates the same amount of sound. The “community interest” in the exempted event may not be more successful than the person’s argument. See section 4.3.2 of Chapter 4.

## **Article X MOTOR VEHICLE SOUND LEVELS**

### **10.1 Motor Vehicles on Public-Rights-of-Way**

*No person shall operate, or cause to be operated, a public or private motor vehicle or motorcycle on a public right-of-way, or on public property, at any time in such a manner that the sound pressure level emitted by the motor vehicle or motorcycle exceeds the limits in Table 6-24 when measured at a distance of (N) feet.*

### **Definitions Needed**

3.1, 3.17, 3.21, 3.23, 3.24, 3.34, 3.39, 3.40, 3.52

### **General Comments**

This provision is an *objective emission* control. It is intended to regulate *moving* sound sources, while Article IX is intended for *stationary* sound sources. Since this article is for sources in public rights-of-way, moving sound sources on private property must be considered. These can be handled as “stationary” sources of varying sound level in Article IX, or in later provisions of this article.

Appendix B has a list of existing state and local laws showing the maximum permitted sound levels by motor vehicles. That appendix should be examined before proceeding.



There are five issues: vehicle type, vehicle speed, maximum sound level, measurement distance, and measurement site.

With regard to vehicle type, the federal government has set levels for motorcycles and trucks used in interstate commerce as opposed to those displayed in Table 6-24. These are standards for the sale of new vehicles and the no-tampering law suggests that communities should use the same numbers; although not all do. See

Vehicle Class	Sound Level, dB(A) at 50 feet	
	Speed Limit 35 mph or less	Speed Limit over 35 mph
Motor vehicle engaged in interstate commerce of GVWR or GCWR of 10,000 lbs. or more	80	80
All other vehicles of GVWR or GCWR of 10,000 lbs. or more	N <sub>1</sub>	N <sub>2</sub>
Street motorcycle	80	80
Off Road motorcycle, less than 170 cc	80	80
Off Road motorcycle, 170 cc or more	82	82
Mopeds	70	70
Any other motor vehicle or any combination of vehicles towed by any motor vehicle.	N <sub>3</sub>	N <sub>4</sub>

**Table 6-24. Motor vehicle sound limits**

Appendix B.1. The community is free to set limits for other vehicles on public rights-of-way.

With regard to vehicle speed, emitted sound increases with speed; increasing from 35 mph to 70 mph typically results in a 12 dB increase. Thus, speed limit categories are reasonable and necessary. The value of 35 mph is normally chosen because it is the speed limit inside most communities. If the community speed limit is 45 mph, it is reasonable to add 4 dB to the values listed in Table 6-24. See Table B-5 in Appendix B. Because vehicle sound increases significantly with speed, it is tempting to create a large number of speed categories, each with different limits. No community has done so, probably for several practical reasons. One is to simplify the task of the NCO and the other is that most vehicles which are loud would be in violation at any speed (e.g. faulty mufflers).

Measurement distance is standardized on fifty (50) feet for vehicle noise monitoring. There is no legal restriction on other distances as long as interference is minimized and the measured level is corrected to the fifty foot distance to match the provisions by using Table C-5 of Appendix C.

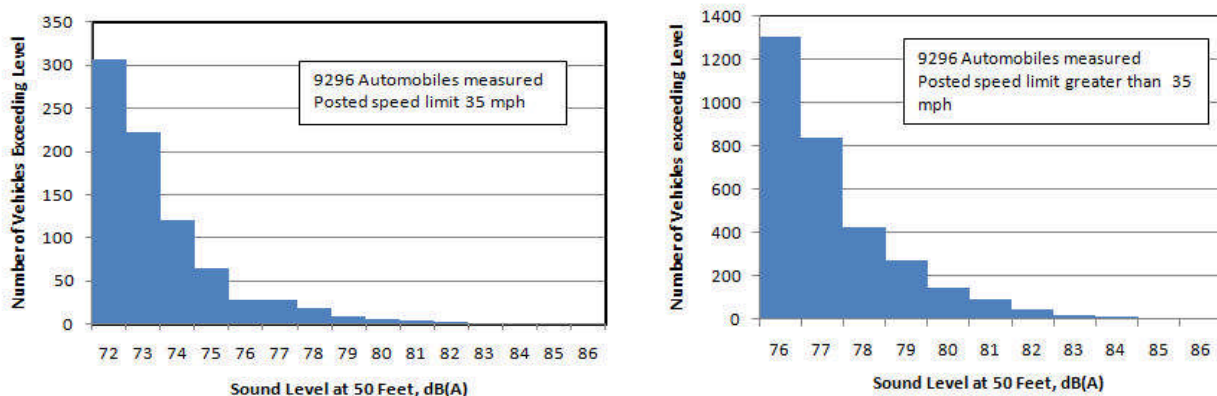
The monitoring site is discussed in Chapter 7.

Recent development of the electric vehicle (EV) has reduced the sound emitted, satisfying many citizens, but it has created a difficulty among another group: the visually impaired. They use vehicle sound as a safety signal. Their association has recommended that an artificial engine sound be required on these vehicles, particularly when they are stopped and moving slowly. {NOff} discusses this issue and notes that Lotus Engineering has a 300 Watt system.

### **Comments on Automobile Sound Level Limits**

Although the health and welfare of “normal” citizenry is a goal of this ordinance, another serious reason for limiting vehicle sound levels in urban areas is because of the Americans with Disabilities Act. Many visually impaired persons navigate outdoors using sound, such as audible crosswalk signals or reflections from buildings. Loud vehicles mask these needed signals.

Trucks used in interstate commerce, as previously noted, have the limits shown in Table 6-24. All other trucks, such as local moving contractors, and delivery trucks, can be regulated by the community. The difficulty sometimes is in separating the two types, suggesting that the limits for both uses be the same. Normal (unmodified) automobile sound levels vary considerably. California collected a sampling of 9296 automobiles sound levels at 50 locations; the data are shown in Figures 6-8 and 6-9.



*Figures 6-8 and 6-9. Motor vehicle sound levels in two speed categories*

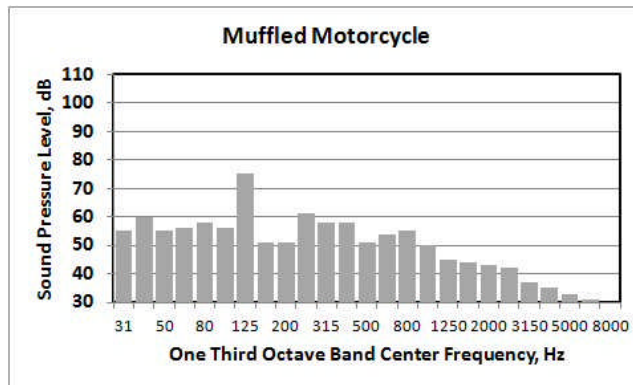
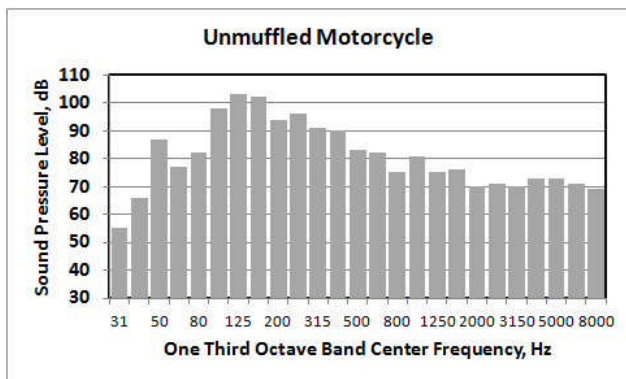
For posted speed limits of 35 mph, less than 1% of automobiles exceed a level 74 dB(A), testifying to the evolution of quiet vehicles. It is notable that a level limit of 76 dB(A) is common among ordinances, and is considered a reasonable number to use as  $N_3$  in Table 6-24. For posted speed limits above 35 mph, less than 1% exceeded 81 dB(A). It is notable that a level limit of 82 dB(A) is common among ordinances, and is considered a reasonable number to use as item  $N_4$  in Table 6-24. There is no information about the state of muffler repair on those exceeding the level. It seems obvious that reasonable maintenance of automobiles will ensure compliance of most noise ordinances. This would simplify enforcement of vehicle noise limits to those having poorly muffled exhausts, which is covered in Provision 7.18 on Tampering.

### Comments on Motorcycle Sound Level Limits

Motorcycles come in a variety of types and sizes. In most communities, the sound from a certain motorcycle type creates the largest number of noise complaints. The primary sound source is the exhaust. It is composed of turbulent flow sound and a nearly pure tone associated with the engine rpm.

The California Highway Patrol measured the sound from 3254 motorcycles on roads with posted speed limits of 35 mph. Close to 10% were in violation of the 82 dB(A) limit. It was noted that most violators had modified mufflers. They also measured 4,884 motorcycles at higher posted speed limits and found more than 15% were in violation of the 86 dB(A) limit. Manufacturers have been aware of the sales appeal of noisy motorcycles. Harley-Davidson distributors make use of this appeal. The argument for years has been that it is difficult and expensive to quiet the motorcycle because it is small and open; also a loud motorcycle is a safer one. A sample measurement was made on two motorcycles driving at 45 mph on a 2% upgrade. Figures 6-10 and 6-11 show passby spectra at 18 feet, a typical distance to a sidewalk. Figure 6-10 shows the sound spectrum of a Harley Davidson motorcycle; the overall level was **103 dB(A)** with a frequency maximum related to engine rpm. Figure 6-11 shows the sound spectrum of a

considerably quieter motorcycle; the overall level was 75 dB(A) with a prominent maximum related to engine rpm. There is a large contribution of turbulent noise at other frequencies on the Harley Davidson and very little from the quieter motorcycle. The quieter motorcycle level was distance adjusted to 50 feet; it would have measured 66 dB(A), while the Harley would have



**Figures 6-10 and 6-11. Sound spectra of unmuffled and muffled motorcycles.**

measured 94 dB(A). It is clear that motorcycles can easily meet the 80 dB(A) limit. The data suggest that proper muffling of motorcycles is a practical technical solution to motorcycle noise; the social solution is a little more difficult (4.6.4 of Chapter 4). The federal limit is 80 dB(A) which is practical, enforceable, and defensible. It is remarkable that a limit of 71 dB(A) is set for “low noise emission products” in 40 CFR 205.152, indicating that such a goal can be achieved by manufacturers. An example of a motorcycle with straight pipes is shown in Figure 6-12.

### Existing Provisions

A recent survey by the state police in New Hampshire found that 13 of 65 motorcycles measured were over **106 dB(A)**, the state limit. Note: The measurement distance was 20 inches so the level was over 76 dB(A) when translated to 50 feet). New Jersey requires a label on all motorcycles certifying that they meet 40 CFR 205. The Boston City Council passed a motorcycle noise ordinance that imposes a \$300 fine on motorcyclists caught with pipes that are not EPA-stamped. It went into effect in 2009. The state of Colorado has had an active noise control program since the 1970’s. For motor vehicles with a gross vehicle weight rating less than 10,000 pounds, their regulation states that the level shall not exceed 82 dB(A) at 25 feet. Since the standard distance is generally 50 feet, this regulation is equivalent to 76 dB(A) at 50 feet. Since this regulation has been in existence for many years it suggests that such a level can be achieved.

Denver, CO has an ordinance on motor vehicle noise identical to the state. In addition, they have a section 38-6 that states:



**Figure 6-12. Motorcycle with straight pipes.**

*”(c) It is unlawful for any person or for any owner to allow any person to modify, tamper with, alter, or change any motor vehicle in any manner that causes the sound emitted from the motor vehicle to exceed the corresponding sound pressure level in Table B. (d) No person shall, nor shall the owner allow any person to, operate a motorcycle manufactured after December 31, 1982 that is not equipped with an exhaust muffler bearing the Federal EPA required labeling applicable to the motorcycle's model year, as set out in Code of Federal Regulations Title 40, Volume 24, Part 205, Subpart D and Subpart E; or a muffler or muffler system in compliance with Table B (the 82 dB(A) limit)”.*

Although not directly relevant to monitoring, Part (c) of the Salt Lake County Noise Ordinance (Section 4.5.10(iii)) is relevant to controlling motorcycle noise (See Provision 7.18). It is:

*“At every point of sale where a noise control system for a motor vehicle, motorboat, snowmobile, or off-road vehicle is offered for sale or sold including, but not limited to, a new or used dealership, part store, muffler shop, or other local retail outlet a conspicuous, large, and clearly legible sign with high contrast bold lettering shall be posted stating:*

**WARNING: ANY NOISE CONTROL SYSTEMS, INCLUDING MUFFLERS AND EXHAUST SYSTEMS THAT DO NOT MEET THE ORIGINAL SPECIFICATIONS OF THE SYSTEM INSTALLED BY THE MANUFACTURER MAY BE IN VIOLATION OF FEDERAL, STATE, OR LOCAL LAW AND SUBJECT TO PENALTIES”.**

{NOFF} describes the potential health effects of loud motorcycle sound, the promoters of them, activities related to motorcycle sound, and some legal aspects. {NFA} has 58 articles on this subject. Of particular interest is the article on a letter from the EPA, and the strong resistance of noise-lovers to ordinances against them. They note that there are several organizations specific to quieting noisy motorcycles.

## Recommended Values

The measurement distance is recommended to be 50 feet. If a different distance is to be in the ordinance, Table C-5 in Appendix C can be used to change the maximum levels. In that way they can be made consistent with the maximum levels at the more commonly used 50 feet.

Most of the level limits in Table 6-24 are set at federal levels and are recommended. The recommended values for the other levels are shown in Table 6-25.

The recommended speed break point is 35 mph to be in conformance with most federal state and local ordinances. Although many communities use 35 mph, it is not necessary to do so if the community has a different speed break point. If the speed break in Table 6-19 is different than 35 mph, the level limits can be changed by reference to Table B-5 in Appendix B. For example, if the speed break point is 45 mph, the level limits should be increased by 4 dB.

Limit Number	Level, dB(A)
N <sub>1</sub>	80
N <sub>2</sub>	80
N <sub>3</sub>	76
N <sub>4</sub>	82

***Table 6-25. Recommended values for Provision 10.1***

## 10.2 Motorboats

### Alternative 1

*Operating, or permitting the operation, of a motorboat on any lake, river, stream, or other waterway in such a manner as to cause a noise disturbance across a real property boundary of a residential zone or in a noise sensitive zone.*

### Alternative 2

*Operating, or permitting the operation, of a motorboat on any lake, river, stream, or other waterway in such a manner as to exceed a sound pressure level of ( $N_1$ ) dB(A) when measured at a distance of ( $N_2$ ) feet, or at the nearest shoreline, whichever distance is less.*

### Alternative 3

*Operating, or permitting the operation, of a motorboat on any lake, river, stream, or other waterway in such a manner as to violate the provisions of Article IX.*

### Definitions Needed

3.1, 3.22, 3.29, 3.30, 3.42, 3.52

### Comments

This provision is either a *subjective immission* control or an *objective emission* control. It considers “motorboats” as watercraft with underwater propellers. (See 10.14 for other types).

Use of powered boats in suburban lakes can cause severe annoyance among shoreline residents; particularly unmuffled speed boats or water ski boats. Regulating motorboats is fundamentally different than that for motor vehicles since the boat can travel over any part of a waterway, and may make multiple passes when on a lake. The first alternative is subjective and intended for shoreline enforcement. The second applies objective sound level limits, requiring measurements. They can be made from an official boat

Community	Time of Day	Maximum Sound Level, dB(A)
California	All times	75
Florida	All times	90 (50 feet)
Kansas	All times	92 (J2005)
Idaho	All times	75
Maine	All times	75
Maryland	All times	90 (J2005)
Minnesota	All times	82 (50 feet)
Missouri	All times	86 (50 feet)
Montana	All times	75
Nebraska	All times	90 (100 feet)
New Hampshire	All times	82 (50 feet)
New York	All times	75 (50 feet)
Oregon	All times	84 (50 feet)
Washington	All times	75(shoreline)
Wisconsin	All times	86
Anchorage, AK	All times	80 (50 feet)
Portland, OR	7 am to 10 pm	75
	10 pm to 7 am	65
Seattle, WA	7 am to 10 pm	74
	10 pm to 7 am	64

**Table 6-26. Motorboat maximum sound levels**



with the suspect boat passing by or from the shoreline. The third is more applicable in a small pond, or restricted area, where it is practical to apply stationary noise source limits; sound level measurements are required.

Note: It is possible to combine the alternatives into one provision.

### **Existing Provisions**

Some poor laws specify a level but no distance at which the level is to be determined. California, Portland, OR and Seattle, WA require measurements to be made at the shoreline. San Diego, CA being a waterfront city, defers regulation to the Harbors and Navigation Code. California also has regulations on the maximum sound of engines used in recreational vessels. Wisconsin requires local ordinances to be identical to that of the state. SAE tests permit sound measurements both of motor boats (J1970 and 2005). Maine permits stationary as well as operational tests. Existing regulations are given in Table 6-26.

### **Recommended Values**

The level of  $N_1$  should be consistent with that applied to motor vehicles on a public right-of-way (Provision 10.1). The value of  $N_2$  distance should be consistent with Provision 10.1. Shoreline can be defined as any place habitable by persons (such as a pier). Shoreline measurement is recommended in preference to a fixed distance.

## **10.3 Recreational Snowmobiles**

### **Alternative 1**

*No person shall operate or cause to be operated, a recreational snowmobile on a public right-of-way or on public property:*

*(a) at any time in such a manner that the sound pressure level emitted by the snowmobile exceeds ( $N_1$ ) dB(A) when measured at a distance of ( $N_2$ ) feet, or;*

*(b) between the hours of ( $N_3$ ) PM and ( $N_4$ ) AM the following day, or;*

*(c) that creates a noise disturbance across a real property boundary in a residential zone or in a noise sensitive zone..*

### **Alternative 2**

*No person shall operate or cause to be operated, a recreational snowmobile vehicle on public or private property:*

*(a) in such a manner that the sound pressure level emitted by the snowmobile exceeds ( $N_1$ ) dB(A) when measured at a distance of ( $N_2$ ) feet, or;*

*(b) between the hours of ( $N_3$ ) PM and ( $N_4$ ) AM the following day, or;*

*(c) that creates a noise disturbance across a real property boundary in a residential zone or in a noise sensitive zone.*

### Alternative 3

*No person shall operate or cause to be operated, a recreational snowmobile on public or private property:*

*(a) within (N<sub>5</sub>) feet of occupied structures or residences, or;*

*(b) at any time in such a manner that the sound pressure level emitted by the vehicle exceeds (N<sub>1</sub>) dB(A) when measured at a distance of (N<sub>2</sub>) feet, or;.*

*(c) between the hours of (N<sub>3</sub>) PM and (N<sub>4</sub>) AM the following day.*

### Definitions Needed

3.1, 3.29, 3.34, 3.39, 3.40, 3.42, 3.45, 3.52

### Comments

Alternatives 1 and 2 are similar in that they contain both *objective emission* controls and *subjective immission* controls. Alternative 1 relates only to public property; private property issues must be handled as time-varying “stationary” sources under Article IX. Alternative 2 gives the NCO the opportunity to use Article IX or this provision. Alternative 3 replaces “noise disturbance” with a distance requirement; it is based on known sound levels of snowmobiles. It is not as precise but does not require sound measurements.

Snowmobile users have argued that snow absorbs engine sounds so they are quieter. Unfortunately, the ambient sound is reduced also, so the signal-to-noise ratio stays about the same; the disturbance occurs at lower sound levels. Early snowmobiles were quite noisy, but since about 1975 efforts to reduce the noise have been successful. However, some are still loud enough to cause disturbance (guttled mufflers?). The main sound sources are the exhaust and the vehicle track. Data suggest that, like motorcycles, noise lovers will modify their mufflers to increase both mechanical and sound power. The tampering provision can be used to handle that issue (Provision 10.6). Anti-snowmobile people cite the adverse impact on wildlife. Information suggests that such impact is negligible as long as the person remains on the vehicle and is on a designated trail.

Community	Maximum Sound Level, dB(A)
Federal	78
California	82
Connecticut	78
Colorado	88
Illinois	73
Iowa	78
Maine	78
Massachusetts	78
Michigan	78
Minnesota	78
New Hampshire	73
New York	73
Oregon	80
Vermont	82
Washington	78
Wisconsin	88 (J2567)
Quebec, Canada	72
Anchorage, AK	76
Chicago, IL	73
Lincoln, NE	78

***Table 6-27. Existing snowmobile maximum permitted sound levels***



## Existing Provisions

Table 6-27 shows some existing maximum sound levels measured at 50 feet for snowmobiles built after 1975. The federal law (36 CFR 2.18) regulates snowmobiles on federal property, so states and communities are free to regulate snowmobile sound levels on their own property. The examples shown are very consistent and the level of 78 dB(A) appears to be a reasonable number for the ordinance. This maximum level is similar to that for automobiles, but the advantage for the community is that most listeners are inside in winter adding more sound attenuation. Maine, Illinois and other states exempt snowmobiles in sanctioned racing events. The difficulties of enforcement are addressed in Chapter 7.

## Recommended Values

Alternative 1 is the recommended provision; it allows for several methods of enforcement. The first part requires that the vehicle be identified and that the NCO be present with equipment to do a passby test. The second part is simpler to enforce, being a curfew. The third is a subjective enforcement where no measurements are required, but a complaint is necessary. Private property issues can be handled by Article IX. Alternative 3 is **not** recommended as it is difficult to determine such large distances and requires a presumption of the sound output. The recommended values for recreational snowmobiles are shown in Table 6-28. These values are consistent with existing laws. The recommended distance is based on a snowmobile meeting the recommended limit at 50 feet and the level at a listener is down to 55 dB(A). Again, if the actual measurement distance is other than that in the provision, Table C-6 in Appendix C can be used to correct the measured level.

Limit Number	Value
N <sub>1</sub>	78 dB(A)
N <sub>2</sub>	50 feet
N <sub>3</sub>	10 pm
N <sub>4</sub>	7 am
N <sub>5</sub>	650 feet

**Table 6-28. Recommended values for snowmobiles**

## 10.4 Recreational Off-Road Vehicles

### Alternative 1

*No person shall operate or cause to be operated, a recreational off-road vehicle on public property:*

*(a) at any time in such a manner that the sound pressure level emitted by the vehicle exceeds (N<sub>1</sub>) dB(A) when measured at a distance of (N<sub>2</sub>) feet, or;*

*(b) between the hours of (N<sub>3</sub>) PM and (N<sub>4</sub>) AM the following day, or;*

*(c) that creates a noise disturbance across a real property boundary in a residential zone or in a noise sensitive zone..*

### Alternative 2

*No person shall operate or cause to be operated, a recreational off-road vehicle on public or private property:*

*(a) at any time in such a manner that the sound pressure level emitted by the vehicle exceeds (N<sub>1</sub>) dB(A) when measured at a distance of (N<sub>2</sub>) feet, or;*

(b) between the hours of (N<sub>3</sub>) PM and (N<sub>4</sub>) AM the following day, or;

(c) that creates a noise disturbance across a real property boundary in a residential zone or in a noise sensitive zone..

### Alternative 3

No person shall operate or cause to be operated, a recreational off-road vehicle on public or private property:

(a) within (N<sub>5</sub>) feet of occupied structures or residences, or;

(b) at any time in such a manner that the sound pressure level emitted by the vehicle exceeds (N<sub>1</sub>) dB(A) when measured at a distance of (N<sub>2</sub>) feet, or;

(c) between the hours of (N<sub>3</sub>) PM and (N<sub>4</sub>) AM the following day.

### Definitions Needed

3.1, 3.29, 3.32, 3.34, 3.39, 3.40, 3.42, 3.45, 3.52

### Comments

Alternatives 1 and 2 are similar in that they contain both *objective emission* controls and *subjective immission* controls. Alternative 1 relates only to public property; private property issues must be handled as time-varying “stationary” sources under Article IX. Alternative 2 gives the NCO the opportunity to use Article IX, or this provision. Alternative 3 replaces “noise disturbance” with a distance requirement; it is based on presumed sound levels of off-road vehicles. It is not as precise but does not require sound measurements.

Off-road vehicles are similar to street motorcycles in their ability to make sound, but do not operate on public rights-of-way. They are similar to snowmobiles in that they operate off-road but they generally operate during warmer months when persons may be outside. The main sound source is the exhaust. Data suggest that, like motorcycles, noise lovers will modify their mufflers to increase both mechanical and sound power. The tampering provision can be used to handle that issue (Provision 10.6). A curfew is another viable option.

Community	Maximum Sound Level, dB(A)
Federal	78
Arizona	(96)
California	82
Connecticut	78
Colorado	96
Iowa	82
Maine	82
Michigan	82
New York	73
Oregon	82
Vermont	82
Washington	86
Wisconsin	(96)
Quebec, Canada	72
Anchorage, AK	76
Boulder County, CO	78
San Diego, CA	76
Seattle, WA	80
Chicago, IL	82 and 86
Lincoln, NE	78

**Table 6-29. Existing off-road maximum permitted sound levels**

### Existing Provisions

. The Table 6-29 shows some existing maximum sound levels measured at 50 feet. These limits are similar to those for automobiles. Colorado Springs, CO applies only the first statement

of Alternative 3 (a minimum distance of 660 feet). Portland, OR does not set a limit but requires that the area must be designated for recreational vehicle use; in this way they avoid having to make sound measurements. Salt Lake City, UT requires the vehicle to be 800 feet from a dwelling during day time hours and has a curfew from 10 pm to 7 am., or if it creates a noise disturbance. Maryland requires the vehicle to be 300 feet away from a residence. {NOff} describes the potential health effects of all-terrain vehicles, off-road bikes, dune buggies, minibikes, and motorized scooters. The site discusses the promoters of them, some legal aspects, and recommended citizen actions. The difficulties of enforcement are addressed in Chapter 7.

### Recommended Values

Alternative 1 is the recommended provision; it allows for several methods of enforcement. The first requires that the vehicle be identified and that the NCO be present with equipment to do a passby test. The second is simpler to enforce, being a curfew. The third is a subjective enforcement where no measurements are required, but a complaint is necessary. Alternative 2 is **not** recommended as it can be more effectively handled in Provisions 9.1. Alternative 3 is **not** recommended as it is difficult to determine such large distances and requires a presumption of the sound output (See section 10.4 in Chapter 7 for more discussion of this aspect). The recommended values for off-road recreational vehicles are shown in the table on the right. These values are consistent with existing laws and are the same as for snowmobiles. Again, if the measurement distance is other than that in the provision, Table C-6 in Appendix C should be used to correct the measured level. The distance for Alternative 3 is based on the sound from a vehicle emitting 78 dB(A), dropping to near 55 dB(A) at 650 feet.

Limit Number	Value
N <sub>1</sub>	78 dB(A)
N <sub>2</sub>	50 feet
N <sub>3</sub>	10 pm
N <sub>4</sub>	7 am
N <sub>5</sub>	650 feet

**Table 6-30. Recommended values for off-road vehicles**

## 10.5 Motor Vehicle Sound Systems

*No person shall operate or cause to be operated, a vehicle sound system on a public right-of-way or on public property, or in a noise sensitive zone at any time in such a manner:*

- (a) that the sound pressure level emitted by the system exceeds (N<sub>1</sub>) dB(A) when measured at a distance of (N<sub>2</sub>) feet, or;*
- (b) as to cause noise disturbance or to be plainly audible at (N<sub>3</sub>) feet from such a device, or;*
- (c) as to create a noise disturbance or to be plainly audible to any person other than the operator of the device, when operated by any passenger on a common carrier.*

### Definitions Needed

3.1, 3.5, 3.29, 3.30, 3.34, 3.36, 3.39, 3.40, 3.52

### Comments

The first part of the provision is an *objective emission* control. The second part is a *subjective immission* control. The third part is an extremely strict *subjective emission* control that

can be applied to buses and other public transportation. The provisions is restricted to the purpose of listening not broadcast (4.4.1 of Chapter 4). Broadcast involves free speech considerations.

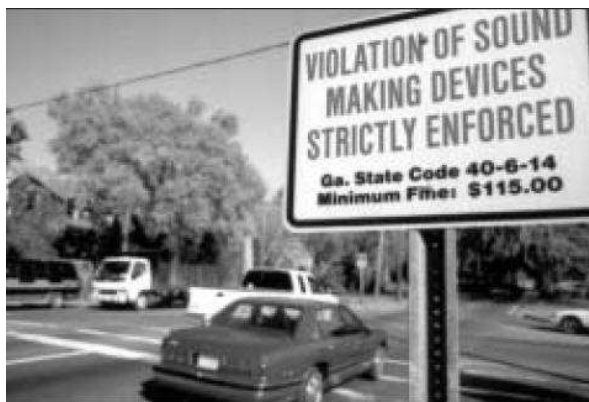
There are competitions to see whose automobile sound level is loudest. It is reported that levels of 150 dB have been achieved. It is common to hear the “thump thump” of passing vehicles. The more invasive problem is the stationary vehicle playing high level music. Typical is a local contractor working on a home with his vehicle parked nearby. Not only do vehicle sound systems create noise disturbance but they also inhibit the vehicle occupants from hearing emergency signals. Thus control of these sources is a valid health and welfare concern.

Playing car stereos loudly can be an act of social defiance by some, or merely inconsiderate behavior by others. For yet others, it is a passionate hobby, an important part of their cultural identity and lifestyle. Judging by the sales of car stereo manufacturers and dealers, the interest in car stereo competitions, and the sums of money spent on car stereos, police are confronting a popular and lucrative phenomenon. It is not easy to change the behavior of those who see loud car stereos as an important part of their lifestyles.

“Plainly audible” does not require that the music lyrics or melody be totally intelligible; the bass vibrations alone can suffice. The specified distances can vary by time of day, typically with shorter distances set for nighttime hours. The advantage of “plainly audible” is it does not require expensive monitoring equipment and the requisite training. Several courts have upheld the plainly audible standard for a noise ordinance in the face of legal challenges (See 4.3.1 of Chapter 4). A disadvantage to plainly audible standards is that enforcers must measure distances, something not easily done while a car is moving. But, with a little training, enforcers can learn to estimate distances. Since persons will use sound systems whenever the vehicle is in use, it is unreasonable to put a curfew on operation.

### Existing Provisions

The most restrictive application of the plainly audible laws says that the sound cannot be audible to anyone other than the vehicle occupants. Louisiana prohibits the system from emitting “sound outside of a vehicle”. Richmond, CA also prohibits the sound from being audible outside the vehicle. Oregon prohibits sound systems plainly audible at 50 feet. California prohibits sound systems that can be *heard* at 50 feet (“heard” is not a good descriptor). Colorado Springs, CO, requires a measurement at 25 feet beyond the private property line or 25 feet from the source on public property; it does not specify a limiting level. In Lakewood, CO it must not be plainly audible beyond 25 feet. In Los Angeles, CA, it cannot be audible beyond 200 feet. In Seattle, WA, it must not be plainly audible at 75 feet. Chicago restricts levels to less than clearly audible at 75 feet. Minneapolis, MN restricts levels to less than audible at 50 feet. Georgia statutes have resulted in the local street sign shown in Figure 6-13. Albuquerque, NM restricts plainly audible to 25 feet, but also applies Article IX limits. Cincinnati, OH restricts plainly audible to 50 feet. Dallas, TX prohibits sound



**Figure 6-13. Georgia sign about loud sound systems**

or vibration that is detectable at 30 feet, or that violates the land use regulations. Houston, TX applies Article IX levels when measured at 15 feet. Omaha, NE states the sound must not be audible at 100 feet. Hammond, IN restricts plainly audible to 25 feet. New Jersey states the sound must not be plainly audible at 50 feet between 8 am and 10 pm and not plainly audible at 25 feet between 10 pm and 8 am. Florida states the sound must not be plainly audible at 25 feet, but exempts business and political systems (a different application than this provision). Oregon and Tennessee state that the sound must not be plainly audible beyond 50 feet as does Fairbanks, AK. Rhode Island specifically addresses low frequency sound that can be heard 20 feet from a closed vehicle or 100 feet otherwise. Salt Lake City, UT considers the sound a violation if it is plainly audible on a common carrier (See 4.4.2 in Chapter 4). {NOff} provides information on what they refer to as “Boom Boxes”. They discuss the marketing of the products, the health effects, and some legal aspects. {NFA} has 47 items about “boom cars” that are worth reviewing. In particular, the site mentions the activity of Sarasota, FL and Peoria, IL, on this issue. Austin, TX states it must not be *audible* at 30 feet (the lack of “plainly” makes it more debatable).

### Recommended Values

The provision allows for several methods of enforcement. The first part is an objective measurement requiring the vehicle to be identified and that the enforcement officer be present with equipment. The problem with that is determining whether the test level is the same as that causing the violation. The second part is subjective enforcement and is the recommended mode of enforcement. The recommended values are shown in Table 6-31. The recommended level is higher than that for automobiles so there is no conflict with the sound from the automobile. The measurement distance  $N_2$  for part (a) of the provision was chosen to be consistent with other vehicle measurement distances. Again, if the measurement distance is other than that in the provision, Table C-6 in Appendix C should be used to correct the measured level. The recommended distance  $N_3$  for part (c) is based on unamplified speech levels discussed Provision 7.1 and shown in Table 6-2.

Limit Number	Value
$N_1$	78 dB(A)
$N_2$	50 feet
$N_3$	100 feet

**Table 6-31. Recommended values for motor vehicle sound systems**

## 10.6 Adequate Mufflers or Sound Dissipation Devices

*(a) No person shall operate, or cause to be operated, any motor vehicle, motorcycle, motorboat, airboat, snowmobile, or off-road vehicle not equipped with a muffler or other sound dissipation device in constant operation and as effective in sound reduction as, or better than, the original equipment.*

*(b) No person shall remove or render inoperative, or cause to be removed or rendered inoperative, other than for the purpose of maintenance, repair, or replacement, any muffler or sound dissipation device on any motor vehicle, motorcycle, motorboat, airboat, snowmobile, or off-road vehicle.*

*(c) The NCO may by (**guidelines/regulations**) approved by (**proper authority**) list those acts which constitute violation of this ordinance.*

(d) *At every point of sale where a noise control system for a motor vehicle, motorcycle, motorboat, airboat, snowmobile, or off-road vehicle is offered for sale or sold including, but not limited to, a new or used dealership, part store, muffler shop, or other local retail outlet a conspicuous, large, and clearly legible sign with high contrast bold lettering shall be posted stating:*

*WARNING: ANY NOISE CONTROL SYSTEMS, INCLUDING MUFFLERS AND EXHAUST SYSTEMS, THAT DO NOT MEET THE ORIGINAL SPECIFICATIONS OF THE SYSTEM INSTALLED BY THE MANUFACTURER, MAY BE IN VIOLATION OF FEDERAL, STATE, OR LOCAL LAW AND SUBJECT TO PENALTIES.*

### **Definitions Needed**

3.22, 3.23, 3.24, 3.25, 3.32 , 3.34

### **Comments**

This provision is an *emission* control. It is a supplement to the tampering Provision 7.18 and applies specifically to motor vehicles. Inclusion and enforcement of this provision will insure that the main source of motor vehicle sound is controlled. The expression “to be as effective as, or better than, the original equipment” is an objective requirement since most original equipment has a sound level limit placed on it. Part (c) is intended for the NCO to catch loopholes in the other parts of the provision. Part (d) of the provision is intended to be *preventive* rather than corrective. It can save persons intending to modify their vehicles from expensive, unauthorized modifications. Note that *owner onus* is included (See 4.1 of Chapter 4).

{NOff} describes the potential health effects of poorly muffled vehicles, the promoters of them, some legal aspects, and recommended citizen actions.

Parts (b) and (d) are not needed if the tampering provision (7.18) is included in the ordinance.

### **Existing Provisions**

Most states and communities require that mufflers on motor vehicles to be “in good working order” which is a subjective definition and is difficult to apply. The “original equipment” requirement is more specific since many federal standards limit the sound created by newly manufactured vehicles. Some ordinances go into extreme detail in defining a muffler. Since the purpose of a muffler is to reduce sound, Definition 3.25 in Chapter 5 and provision (a) is considered adequate. California requires that a retail seller that sells a product in violation of the muffler regulation (27150.1) must install a replacement muffler that meets the regulation and must reimburse the purchaser for the expense of replacement.

## **10.7 Motor Vehicle Horns and Signaling Devices**

(a) *The sounding of horns or other audio signaling devices on or in any motor vehicle, motorcycle, motorboat, snowmobile, or off-road vehicle on any public right-of-way or public property, except as a warning of danger prescribed in the motor vehicle code, or;*



(b) the sounding of any horns or other audio signaling device produces a sound pressure level in excess of ( $N_1$ ) dB(A) when measured at a distance of ( $N_2$ ) feet.

(c) Motor vehicle theft alarms and emergency sirens on authorized vehicles are exempt from this provision.

### Definitions Needed

3.22, 3.23, 3.24, 3.32, 3.39, 3.40, 3.52

### Comments

This provision is an *emission* control. In some parts of the United States, horns are used as a means of personal expression rather than as a danger signal. Some use is due to frustration, lack of discipline, or for signaling a nearby person. Excessive or repetitive use is a cause of noise complaints, particularly in residential areas. This provision also permits enforcement on those who have added very loud horns in addition to the horns provided with the vehicle (e.g. air horns). The first part is subjective and is used most often, while the second part is objective and is intended to prevent excessively loud horns.

Although part (c) is standard for most noise ordinances, it is essentially a different problem. Vehicle theft alarms are addressed in Provision 10.8. One of the most ubiquitous sounds in a community is a siren operated by police, fire, or medical persons. The nature of the signal always raises tension in listeners due to its “emergency” characteristic. The use of lights and sound to permit these vehicles to gain right-of-way is important. Insurance companies protect themselves against claims for accidents when the siren or lights are not in use. The levels are often sufficiently loud to cause *permanent* hearing loss to those frequently exposed to them. With air conditioning on and closed windows on nearby vehicles and the increased sound attenuation from outside, it suggests the need for even louder sirens. A new development is the “Rumbler” or “Howler” addition to the siren. It creates an intense low frequency sound intended to shake nearby listeners and parts of a listener’s vehicle so the emergency vehicles presence is more obvious. {NOff} describes the Rumbler, the manufacturers, and the increasing interest among police departments. They provide a video showing the nature of the sound. {NFA} has 22 articles about the Rumbler.

It is very common for an emergency vehicle to turn on the siren, and leave it on whether it is needed or not. An experiment was performed in the 1970’s in Boulder, CO. Sirens were used only in locations where they were obviously needed and only during the emergency. Two favorable results were found. There was no increase in accidents and the transition from Off to On increased the alertness of nearby persons. Another “emergency” use is the connection of an official radio to a vehicle loudspeaker to communicate with officials that are out of their vehicle. Excessive use should be prevented by policy. Oregon prohibits signaling sound when an emergency vehicle is stationary or returning from an emergency. California prohibits a person operating a motor vehicle to wear a headset or earplugs on both ears.

### Recommended Values

Due to lack of data, no recommended value for  $N_1$  is available. The recommended distance for  $N_2$  is 50 feet to be consistent with the other vehicle provisions.



## 10.8 Motor Vehicle Theft Alarms

### Alternative 1

(a) *The sounding of any motor vehicle, motorcycle, motorboat, snowmobile, or off-road vehicle theft alarm that does not automatically and completely silence after (N) minutes.*

(b) *The alarm sound may not be similar to that of an emergency vehicle siren or civil defense warning system.*

### Alternative 2

*No motor vehicle shall be equipped with an audible theft alarm.*

### Definitions Needed

3.22, 3.23, 3.24, 3.32

### Comments

This provision is an *emission* control. The issue is both frequency and duration. Excessively sensitive alarms are known to sound frequently (false alarms). Some persons seem to enjoy passing close to parked cars in order to set off alarms. The duration of the signal, if not automatically controlled, requires the attention of the owner to silence. At night in high rise apartment buildings, that can be a long time. Alarms that silence automatically are available and should be required. In addition, *silent* alarms that signal the owner's pager have been developed. There are other protection methods available, such as steering wheel locks or brake pedal locks. There are passive immobilizers that prevent engine startup. Theft rates on vehicles with these devices are lower than those with alarms.

### Existing Provisions

Los Angeles, CA requires silencing in 5 minutes. Auto theft in New York City, NY is so large it creates a general noise problem; they require automatic shut-off after 10 minutes and a prominent display of the local precinct number and telephone number (presumably so that local residents can call police to shut the alarm off). Boston, MA considers it a violation if the alarm is plainly audible at 200 feet and is on more than 5 minutes. New Jersey limits continuous operation to less than 5 minutes and intermittent sound to less than 20 minutes. Colorado Springs, CO limits the time to 15 minutes. Connecticut limits the time to 10 minutes. Hartford, Ct limits the time to 10 minutes. Some cities have gone the next step and made audible alarms illegal. {NOff} describes the potential health effects of alarms, the promoters of them, some legal aspects, and alternatives to them. {NFA} has several articles on this subject, particularly events in New York City. They note that car alarms are "laughingly ineffective" and should be banned.

### Recommended Values

The value N is recommended to be 5 minutes. Alternative 2 is preferred to Alternative 1 if alternate methods of alarm are available.

## 10.9 Motor Vehicle Tire Squeal\Street Drag Racing

*(a) No person shall operate, or permit to be operated, any motor vehicle, motorcycle, or off-road vehicle that creates a noise disturbance across a real property boundary in a residential zone or in a noise sensitive zone due to tire squeal.*

*(b) No person shall operate, or permit to be operated, any motor vehicle, motorcycle, or off-road vehicle that creates a noise disturbance across a real property boundary in a residential zone or in a noise sensitive zone due to the sound of high acceleration.*

### Definitions Needed

3.23, 3.24, 3.29, 3.30, 3.32, 3.34, 3.42, 3.45

### Comments

This provision is a *subjective* immission control. The high pitch and high level of a squealing tire is a cause of startle response and is universally rejected as excessive and unnecessary. From a safety viewpoint, control of the vehicle is momentarily lost. Note that the above provisions apply to both public and private property.

### Existing Provisions

Illinois prohibits such operation statewide. Hammond, IN, prohibits squeal if it creates a noise disturbance. Note that *owner onus* is included (See 4.1 of Chapter 4). The increased engine sound of accelerating vehicles in a street race almost always exceeds the provisions of 10.1, and is also a non-acoustical safety hazard.

## 10.10 Refuse Collection Vehicles

### Alternative 1

*No person shall operate, or permit to be operated, any compacting device of any motor vehicle in a residential area or in a noise sensitive area that creates a sound pressure level during the compacting cycle in excess of ( $N_1$ ) dB(A) when measured at a distance of ( $N_2$ ) feet from the loudest part of the vehicle.*

### Alternative 2

*No person shall operate, or permit to be operated, any compacting device of any motor vehicle in a residential zone or in a noise sensitive zone that creates a sound pressure level during the compacting cycle in excess of ( $N_1$ ) dB(A) when measured at a distance of ( $N_2$ ) feet from the loudest part of the vehicle between the hours of ( $N_3$ ) PM and ( $N_4$ ) AM the following day.*

### Alternative 3

*No person shall operate, or permit to be operated, any compacting device of any motor vehicle [or collect refuse] that creates a noise disturbance across a real property boundary of a residential zone or in a noise sensitive zone.*

### Definitions Needed

3.1, 3.24, 3.29, 3.30, 3.34, 3.42, 3.45, 3.52

## Comments

Alternatives 1 and 2 are *objective emission* controls while Alternative 3 is a *subjective immission* control. Refuse collection in large cities can be a nearly continuous process, and reflected sound levels add to the cacophony in cities with numerous high rise buildings. Three versions of the provision are provided. The first permits refuse collection at any time of day but limits the sound emission. The second limits the sound emission during permitted hours and includes a curfew. These may be enforced by an NCO at any location including a testing site. The third is a subjective provision and is generally complaint based. The major sound sources on the vehicle are the hydraulic pump and increased engine RPM to power it.

## Existing Provisions

A number of cities have regulations limiting the maximum sound from them as shown in Table 6-32. The Los Angeles, CA time limit applies *only* within 200 feet of any residential building. Chicago, IL considers it a noise disturbance if the activities occur between 10 pm to 7 am. Salt Lake City, UT considers it a noise disturbance if the activities occur between 10 pm to 7 am and closer than 800 feet from a dwelling. Atlanta, GA prohibits activity during the curfew hours, only if the distance to a residential zone, or multi-family dwelling is less than 1500 feet. The city exempts plastic containers. Madison, WI limits the distance to 200 feet from residential areas during curfew hours. In Maryland, refuse collection is exempt during daytime hours and must meet maximum land use levels [55 dB(A)] in residential zones at night. Albuquerque, NM does not set maximum levels, but specifies non-curfew times for two zones within the city.

Community	Maximum Sound Level, dB(A)	Curfew Hours
Albuquerque, NM	None	8 pm to 7 am Weekdays 10 pm to 7 am weekends
Atlanta, GA	None	11pm to 6 am Weekdays 11 pm to 8 am weekends
Charlotte, NC	<300 feet	9 pm to 7 am
Dallas, TX	None	10 pm to 7 am
Milwaukee, WI		
Hammond, IN	None	7 pm to 7 am
Lakewood, CO		10 pm to 7 am
Los Angeles, CA	None	9 pm to 6 am
Madison, WI	None	10 pm to 6 am
Milwaukee, WI	< 200 feet	10 pm to 7 am
New York City, NY	70 (10 Feet)	
San Diego, CA	None	7 pm to 6 am
San Francisco, CA	75 (50 Feet)	

**Table 6-32. Existing sound limits for refuse collection vehicles**

## Recommended Values

The recommended values are shown in Table 6-33. Values  $N_1$  and  $N_2$  are for stationary tests by the NCO at the loudest part of the vehicle. The actual level in the ordinance should be determined by measurement of the refuse vehicles

Limit Number	Value
$N_1$	85 dB(A)
$N_2$	10 feet
$N_3$	10 pm
$N_4$	7 am

**Table 6-33. Recommended values for refuse collection vehicles**

used in the community. Curfew hours should be consistent with other provisions, such as Article IX.

## 10.11 Standing Motor Vehicles

*No person shall operate, or permit the operation of, any motor vehicle with a gross vehicle weight rating (GVWR) in excess of ten thousand (10,000) pounds, or any auxiliary equipment attached to such a vehicle, for a period longer than (N<sub>1</sub>) minutes in any hour while the vehicle is stationary within (N<sub>2</sub>) feet of a residential zone or noise sensitive zone between the hours of (N<sub>3</sub>) PM and (N<sub>4</sub>) AM the following day. [Operation in a public right-of-way or on public property is exempted.]*

### Definitions Needed

3.17, 3.24, 3.30, 3.34, [3.39, 3.40,] 3.45

### Comments

This provision is a *subjective emission* control since it contains no sound level limits. Trucks with operating engines at loading docks adjacent to a residential area can create a noise disturbance. This may also be covered by Provision 7.5 if loading operations are conducted. The same can happen at motels; in winter months, truckers like to keep the engine on and the cab warm. Some trucks have refrigeration units that have to run periodically, hence the allowance for periodic operation. Most of these trucks are used in interstate commerce, but this provision does not conflict with federal law. Note that no sound level measurement need be made.

### Existing Provisions

Chicago, IL limits the time to 4 minutes if the vehicle is within 150 feet of a residence. In Salt Lake City, UT it is considered a noise disturbance if the operation lasts more than 15 minutes. Dallas, TX applies the code to vehicles over 14,000 GVWR; they must be more than 300 feet from a residential zone and there is a 10 minute maximum. They also provide a list of idling vehicles that are exempt from prosecution such as buses or active concrete trucks. Hammond, IN limits operation to 3 minutes in an hour for vehicles over 14,000 GVWR in either public or private property. Massachusetts allows idling no more than 5 minutes.

### Recommended Values

The recommended values may vary with the community, particularly those having industrial or commercial zones, including motels, in close proximity to residential areas. The distance N<sub>2</sub> is based on an idling being less than 80 dB(A) at 10 feet. About 55 dB(A) is achieved at 100 feet. Curfew hours should be consistent with other provisions, such as Article IX. Exemption for public rights-of-way is **not** recommended as many idling vehicles may be parked on public property in residential zones. Enforcement would not occur for traffic stops, but should be possible against cars parked on a residential street. Enforcement is expected to be complaint based.

Limit Number	Value
N <sub>1</sub>	10 minutes
N <sub>2</sub>	100 feet
N <sub>3</sub>	10 pm
N <sub>4</sub>	7 am

**Table 6-34. Recommended values for standing motor vehicles**

## 10.12 Motor Vehicle Racing Events

(a) *No person shall operate, or permit the operation of, any racing motor vehicle whose muffler does not reduce the sound emitted by ( $N_1$ ) dB under full acceleration, or any racing motorcycle whose muffler emits a sound pressure level greater than ( $N_2$ ) dB(A) at 0.5 meters (20 inches), or any sports car racing vehicle that emits a sound pressure level greater than ( $N_3$ ) dB(A) at ( $N_4$ ) feet.*

(b) *All events shall be monitored by track personnel.*

(c) *Events shall be terminated by ( $N_5$ ) PM.*

(d) *Unauthorized events are prohibited.*

### Definitions Needed

3.1, 3.23, 3.24, 3.25, 3.52

### Comments

This provision has several *objective emission* controls. There are a wide variety of racing events, ranging from drag strips, motocross events, to speedway races. Drag strip sound, with Nitro fueled vehicles, is extremely high. Attendees love noise at racing events and the profitability makes city councils favorable toward them. However, race tracks that were once in rural areas have been surrounded by residential areas with resulting noise and traffic conflict. It is not practical to have such events indoors, so community impact is inevitable. Since events can happen during evening hours as well as during the day, sleep interference as well as speech interference will occur. *Permanent* hearing loss by car drivers are strong possibilities as well as temporary hearing loss (temporary threshold shift) by the audience.

One set of measurements made in Colorado showed that the driver of a stock car was exposed continually to 115 dB(A) with peaks as high as 128 dB(A) while the audience was continually exposed to 85 dB(A) with peaks as high as 118 dB(A). Community levels varied from 90 dB(A) nearby to 65 dB(A) at 2 ½ miles. Concern is for the health and welfare of the drivers, audience, as well as surrounding residents. The sound levels in tests for a drag strip varied between 80 and 90 dB(A) at about 1300 ft.

The best technical resolution is to reduce vehicle sound production with muffling devices. Unfortunately it is a very unpalatable solution to event managers and drivers. See 4.6.2 and 4.6.3 in Chapter 4. A search was unable to locate any communities that demand mufflers. Barriers are partial solutions in that they must extend completely around the facility and must be very high to provide the needed attenuation. The real issue is money vs. community quiet. The vehicle owners spend money in local shops; the attendees spend money at the site as well as in the community for such items as lodging. The community has an enhanced tax base.

### Existing Provisions

Many states and communities exempt racing event from noise restrictions. Arizona exempts racing motorcycles from maximum sound levels and muffler requirements, limiting the power of local communities to regulate races. Illinois had detailed regulations on racing vehicles (35.903) on which the above provision was modeled.  $N_1$  was 14 dB reduction;  $N_2$  115 dB(A) ; and  $N_3$  was 105 dB(A). There are several exceptions and variations to the above numbers.

### Recommended Values

Since there are a wide variety of vehicles, track events, and distances to residential areas, it is not possible to recommend specific *emission* levels for vehicles; the best that can be done is to require a certain degree of sound reduction. For this, the *former* Illinois regulations are shown in Table 6-35. State regulations should be examined if regulation is contemplated. The value of  $N_3$  measured at 50 feet is equivalent to the value of  $N_2$  measured at 1 meter. Based on the popularity of racing events and the sound created by them, noise control of them is difficult. Curfews are realistic, but the times may be dependent on the day-of-the-week. It is always possible to use Article IX for maximum *immission* levels. Preventive measures are licensing and land use controls. The land use controls are site approval for new tracks and residential site approval near existing tracks.

Limit Number	Value
$N_1$	14 dB reduction
$N_2$	115 dB(A)
$N_3$	87 dB(A)
$N_4$	50 feet
$N_5$	10 pm

**Table 6-35. Recommended values for motor vehicle racing events**

### 10.13 Engine Braking Devices

#### Alternative 1

*No person shall operate any motor vehicle with an engine braking device engaged which does not have a muffler in good working order.*

#### Alternative 2

*No person shall operate any motor vehicle with an engine braking device engaged within the city limits unless required for safety.*

#### Definitions Needed

3.13, 3.24, 3.25, 3.34

#### Comments

This provision is an *emission* control. Engine braking devices (sometimes called “Jake brakes”) are used to supplement the vehicle’s wheel brakes by converting the engine from a power generator to a power absorber. This is done by changing valve timing so the engine becomes an air compressor. On steep declines its use is an added and valuable safety feature. With the engine acting as an air compressor, very powerful bursts of air are periodically sent into the muffler system. For vehicles with such brakes, the original manufacturer mufflers are adequate to control the sound emitted. Pro-noise truckers think the extra sound is desirable. They not only remove the effective muffler but also use the brake in suburban and urban areas where their use is not necessary. The federal sound emission limits for trucks (40 CFR 205) does not exclude the use of these brakes, so the limits of Table 6-19 apply as does Provision 10.6 on anti-tampering.

#### Existing Provisions

Some jurisdictions prohibit the use of “Jake Brakes” in their area such as shown in the first of Figure 6-14. That name is specific to the Jacobs Vehicle Systems company and may



conflict with their trademark rights. It is recommended that “Engine Braking Devices” be used instead. Some cities use Alternative 2, probably based on the concept that vehicle speed should be sufficiently slow that engine brakes are not required. Those communities use cautionary signs such as that shown in the second of Figure 6-14. Oregon uses a sign that complies with the law (ORS 811.492) as shown in the lower of Figure 6-14.

It is easy to identify the characteristic sound of an engine brake when it is in use, so identifying vehicles that require enforcement is not difficult. The Jacobs Vehicle Systems site plays audio files showing how distinctive that sound is. They point out that a straight muffler is from 16 to 20 dB louder than a proper muffler. When a proper muffler is used, brake use increases sound levels only a few dB.

Portland, OR does not define truck routes but requires that trucks of 10,000 lbs GVWR shall not use engine brakes within 200 feet of a residence in a residential area. Milwaukee, WI prohibits engine brake use within the city limits. Many steep grades around Albuquerque, NM have signs requiring engine brakes with proper mufflers. {NOff} believes these brakes are to minimize the cost of maintaining wheel brakes and their use have been expanded to tow trucks, utility, and emergency vehicles. Illinois permits counties and municipalities to prohibit excessive noise from engine brakes except in emergency situations. They define “excessive” as a muffler not “in proper working order”. The state permits the erection of signs. Washington State permits local jurisdictions to implement more restrictive laws than those of the state. Colorado Springs, CO prohibits use within the city limits unless” posted by the City Engineer”.

### Recommended Values

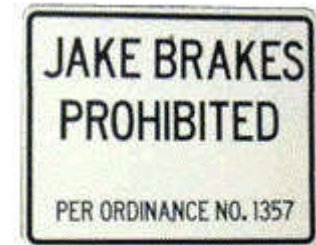
Since the brake is a safety device, its use should not be absolutely prohibited. In cities that are reasonably level, their use should be restricted to emergency stops. Proper mufflers should be required in all areas and informational signs on steep grades are recommended. Application of anti-tampering provisions and periodic monitoring for unmuffled vehicles is recommended. The sound level limits of Provision 10.1 apply.

## 10.14 Airboats/Hovercraft

*No person shall operate or cause to be operated, a watercraft or a hovercraft on a public right-of-way or on public property driven by an aerodynamic propeller:*

*(a) at any time in such a manner that the sound pressure level emitted by the vehicle exceeds ( $N_1$ ) dB(A) when measured at a distance of ( $N_2$ ) feet, or;*

*(b) between the hours of ( $N_3$ ) PM and ( $N_4$ ) AM the following day, or;*



*Figures 6-14. Dynamic brake use signs*



(c) that creates a noise disturbance across a real property boundary in a residential zone or in a noise sensitive zone, or;

(d) in which vehicle occupants do not have ear protection with at least 20 dB reduction. In commercial operations, the occupants shall be provided with such protection.

### Definitions Needed

3.1, 3.11, 3.29, 3.39, 3.40, 3.42, 3.45, 3.52

### Comments

This provision has both an *objective emission* control and a *subjective immission* control, giving the NCO some flexibility. Airboats must be distinguished from “motorboats”. Although both have internal combustion engines that create sound, airboats have propellers as an additional source. There are two varieties: a hovercraft (an air cushion vehicle that is distinguishable from aerial hovercraft in 7.26) that can navigate on either land or water, or and the airboat (aerodynamic propeller driven watercraft). The engines may be up to 1000 horsepower. They are two major sources: engine exhaust that can be controlled by proper muffling and the aerodynamic sound from the blades which are difficult to muffle. The driver and passengers, being close to the blades, are exposed to temporary hearing shifts in current designs. Item (a) allows for an operational test or stationary test, depending on the numbers chosen. Item (b) places a curfew on operations. Item (c) is the subjective immission control. Note that unlike the motorboat provision, there is no “shoreline” phrase since hovercraft can navigate over land and some airboats are capable of a portage. Item (d) requires that no vehicle shall be operated without each occupant having effective ear protectors. Typical levels are near 100 dB(A) on the boat. For that sound output, desired residential levels of 55 dB(A) can only be reached at about 1500 feet. The public property restriction is added, since private property restrictions are covered in Article IX.

There are a number of technical methods that can be used to quiet these vehicles. Effective mufflers for the exhaust of internal combustion engines are needed. The sound of propellers decreases by 18 dB for each halving of RPM. Bigger and slower fans reduce sound in the same way commercial jet sound has been reduced. Blade shrouds reduce and redirect the tip vortex sound. Increasing the number of blades is a negative since it puts the blade tone in the middle of the hearing range. At some point, small, compact, jet engines can be used; they would eliminate the pure tone aspect of the sound.

### Existing Provisions

Florida requires mufflers on watercraft that limit levels(327.65). The Florida limit implies that desired residential levels of 55 dB(A) can only be reached at about ½ mile. Maine provides three limits on airmobiles: an operating limit of 78 dB(A), an operational test of 75 dB(A) and a stationary test of 90 dB(A).

Community	Vehicle	Maximum Sound Level, dB(A)
Florida	Airboat	90
Maine	Airmobile	78

**Table 6-36. Airboat maximum sound levels**

### Recommended Values

Airboats are best operated during daylight hours which will vary with location, so a daylight curfew is recommended. The recommended level is technically feasible, but would only bring the level down to 60 dB(A) at 500 feet and 55 dB(A) at about 900 feet.

Limit Number	Value
N <sub>1</sub>	80 dB (A)
N <sub>2</sub>	50 feet
N <sub>3</sub>	7 pm
N <sub>4</sub>	7 am

**Table 6-37. Recommended values for airboats**

## 10.15 Railroads

*[No provision].*

### Comments

The social problem with train noise is that they pass by discontinuously, are controlled by the federal government when they are used in interstate commerce, and create noise impact in the nearby community. The technical problem is that there are several sources of sound, the locomotive (generally diesel), the rail car wheels, and the horns as roadway crossings are approached. Trains driven with suspended electric power are considerably quieter.

Federal law (40 CFR 201.12) limits the total sound from locomotives and rail cars in motion, used in interstate commerce, and manufactured after 1980 to 90 dB(A) at 100 feet when moving at any time or under any condition of grade, load, acceleration, or deceleration. This is entirely unsatisfactory from a listener's point of view; the distance to achieve a level of 55 dB(A) is approximately **one mile** based on inverse square law spreading.. Because of preemption, there is little a community can, or has been able to, do about the locomotive sound.

### Existing Provisions

Despite preemption, two communities have ordinances that restrict train noise. Colorado Springs, CO considers railroad rights of way as industrial zones and restricts sound level to that specified for industrial zones. There is no information on their ability to enforce. The Indianapolis, IN ordinance states:

Railway cars, buses. Causing or permitting unreasonable noise in the operation of a bus or railway car by reason of defective conditions therein or of its tracks and continuing to do so after being asked to stop.

Apparently, they use the words "defective conditions" as an exception to federal law. No evidence has been found that controlling train speed through a community successfully reduces noise impact.

The court in *State vs. New York Cent. R. Co.*, 37 N.J. Super. 42, 48 (App. Div. 1955), stated:

"That there may be marginal cases in which it is difficult to determine the side of the line on which a particular fact situation falls, is not a sufficient reason to hold the language too ambiguous to define a penal offense." No more than a reasonable degree of certainty can be demanded. In that case, the defendant was found liable for violating a noise ordinance which read, in part: "Whatever loud and unnecessary noise which disturbs the public peace . . . between the hours of

Eleven o'clock P.M. and Seven o'clock A.M. is hereby declared a nuisance and is prohibited."

The defendant's idling train engines caused loud and unnecessary noise during the night. Note this case was prior to passage of 40 CFR 201. 12.

New York City (24-235) states:

(a) On or before September first nineteen hundred seventy-three, the commissioner shall define and submit to the city council for enactment into this code allowable sound levels and acoustical performance standards for the operation of new and existing railroads, including allowable sound levels and acoustical performance standards for rolling stock, bridges, ferries, tunnels, equipment, switches, spurs, tracks, stations, yards and terminal facilities.

Allowable sound levels and acoustical performance standards except as otherwise provided in this section, shall be based on the latest economically feasible and available technology for noise abatement in railroads and on the latest scientific knowledge useful for indicating the kind and extent of all effects on public health, welfare, safety and comfort which can be expected from noises or combinations of noises generated by railroads.

(b) No person shall operate or permit to be operated a railroad, including but not limited to its rolling stock, bridges, ferries, tunnels, equipment, switches, spurs, tracks, stations, yards and terminal facilities, so as to cause a violation of allowable sound levels or acoustical performance standards adopted by the city council pursuant to this section.

Lincoln, NE has added the federal levels to their ordinance. This gives the local noise control officer the authority to enforce them.

### **Comments on Train Horns and Quiet Zones**

The major problem in most communities is the sound of the train horn before reaching road or path crossings. A Federal Railroad Administration report stated:

Field measurement data show an average level of 107 dB(A) at 100 feet from the nearest track represents the horn noise in the distance from 1/4 mile to 1/8 mile from a crossing. Starting at the 1/8 mile point, the data show the horn is sounded more continuously, and more loudly, in the last part of the blowing sequence as the train reaches the crossing. Consequently, the level increases to 110 dB(A) at the roadway crossing.

At 110 dB(A), the distance to achieve 55 dB(A) is about **5 miles!** This is a greater problem than the train sound, since most communities will have crossings in them. For example, Illinois estimates that 64 percent of its population lives within a mile of a crossing.

One method of alleviating train horn sound is to provide enough physical crossing safety so that the horn is not needed. Although train horns have been used since the beginning of railroading, they are not prevention mechanisms, only physical barriers are. A **quiet zone** is a railroad grade crossing at which trains are prohibited (except for emergencies) from sounding their horns in order to decrease the noise level for nearby residential communities. The train horns can be silenced only when other safety measures compensate for the absence of the horns. The Federal Railroad Administration (FRA) train horn rule 49 CFR 222 provides localities

nationwide with the opportunity to establish quiet zones. The federal rule pre-empts all applicable state laws. To qualify, communities wishing to establish quiet zones must equip proposed grade crossings with adequate safety measures to overcome the decrease in safety created by silencing the train horns. The additional safety measures must be constructed at the *community's own expense* (no federal or state funding is allowed) and must meet federal specifications.

Examples of passive safety devices include: circular advance warning signs, stop signs, Crossbucks (the familiar X-shaped signs), pavement markings, and median barriers. Active devices are those that become active as a train approaches. They can include: two quad gates, four quad (full barrier) gates, flashing lights, bells, yield signs, special highway traffic signals, and even a flagman. Despite these restrictions, a large number of communities have established quiet zones. Communities in Florida, Wisconsin, Minnesota, Indiana and Virginia have large numbers of quiet zone crossings.

### **Recommendations**

Quiet zones are recommended for communities that can afford the upgrades to crossings. An example of an ordinance written in the Village of Shorewood Hills, Wisconsin, is given below.

Whereas the Village of Shorewood Hills has five railroad crossings within the Village limits that pass through residential and commercial areas of the Village, and Whereas current safety practices require the railroad to sound whistles at each crossing, disrupting the environs of the community, and

Whereas the Village of Shorewood Hills, in consultation with the Wisconsin & Southern Railroad Company, the Federal Railroad Administration, and the Wisconsin Office of the Commissioner of Railroads, has proposed to enhance the safety measures at each crossing to improve crossing safety in the absence of train whistles, and

Whereas the Village of Shorewood Hills aspires to improve the quality of life for residents affected by train whistles, and improves the level of safety for all motorists and pedestrians at railroad crossings,

Now therefore, be it resolved by the Board of Trustees of the village of Shorewood Hills that the Village requests that following implementation of the crossing safety measures, the Wisconsin Office of the Commissioner of Railroads designate the Village railroad corridor as a quiet zone, in which the use of train whistles is limited to emergency situations.

## Chapter 7

# Community Noise Ordinance Enforcement

*This chapter contains information on the enforcement of a noise ordinance. It discusses the requirements for proper usage of sound level meters, as well as general approaches to enforcement. It also includes a detailed listing of recommended technical enforcement methods for each of the provisions in Chapter 6.*

If the will or ability to enforce a noise ordinance is absent, it is nothing more than a placebo to placate noise sensitive citizens. Having an ordinance that includes only those provisions important to the community increases the will of those responsible for enforcement. Not only must the provisions be technically enforceable and have a sound legal basis, but they must also be realistically enforceable. To this end the noise control officials (NCO) must have the support of community officials, the citizens, and some leeway in enforcement. Since the most successful ordinance contains maximum sound levels, meters are required. High quality meters are readily available at a reasonable cost.

### Enforcement Officials

Most officials assigned to noise ordinance enforcement consider any additional tasks as overload and are generally reluctant to take them on. The addition of more personnel to offset this reluctance can be costly. In most communities, the police are assigned noise ordinance enforcement, and if training and tools are made available there always seems to be a person within the agency who is willing to accept the challenge. Immediately after the passage of the Noise Control Act of 1972, communities developed officials with titles like Environmental Protection Officer (EPO) or Noise Control Officer (NCO). After the demise of the Office of Noise Abatement and Control in EPA, only a few communities retained the staff from this development. In every case, the official chosen had, or has, the ability to cite offenders.

The number of individuals assigned to noise ordinance enforcement will vary with community size and the extent of the problems. Smaller cities use the Police Department as the enforcing agency. In Prescott, AZ there is a volunteer group called "Citizens on Patrol" to do monitoring. They act as eyes and ears for the police, but since they do not have enforcement authority, they simply report potential violations. A side benefit is that the volunteers are now educated on police problems and can be used for educational purposes. Consideration should be given to using this low cost group for noise monitoring.

In larger communities, such as Portland, OR, a police officer may have the title of Noise Control Officer. If there is concern about the environment, the community may consider noise as an environmental pollutant and assign noise control duties to an Environmental Protection Officer. If noise is a serious problem, the community may have a Noise Review Board that can evaluate the effectiveness of the ordinance and recommend changes. Boston, MA permits the ordinance to be enforced by any police officer, any special police officer, any designee of the Air Pollution Control Commission, or of the Board of Health, Hospitals, or of the Commissioner of Inspectional Services. The police of Burlington, VT and Savannah, GA enforce the noise ordinance. Charlotte, NC has a designated NCO (Noise Control Officer). In Chicago, IL, noise

measurement regulations are developed by the Commissioner of Environment. In Albuquerque, NM and Salt Lake County, UT the Health Departments are the lead agency for noise ordinance enforcement.

## **Enforcement Tools**

Modern technology is evolving rapidly, giving citizens and an NCO a number of tools for defining and documenting noise problems, and enforcing the noise ordinance. Applications of specific tools are discussed in the relevant sections of this chapter and are discussed here only in general.

### **Training**

Training in technical enforcement of a noise ordinance is seldom part of a noise control program, but should be a primary tool. Informal enforcement training can be obtained from nearby communities or a state with active enforcement programs. Formal training can be obtained from the Rutgers University, Noise Technical Assistance Center. Every state has people expert in the use of sound level meters so they should be contacted.

### **Sound Level Meters**

For many ordinance provisions a sound level meter is not required, but for those with numerical level limits, they are absolutely necessary. Appendix E discusses the attributes of sound meters. The needed attributes should be determined from examination of the ordinance provisions.

### **Cameras**

Photographs are very important when cases are taken to court. A number of noise sources need to be identified visually, ranging from barking dogs to license plate numbers.

### **Sound Recorders**

Any device that can continuously record sound can be helpful in identifying the character of the sound heard. This is particularly useful for enforcing subjective provisions, such as plainly audible. Its strength is that the event can be heard by other listeners, such as in a court, to eliminate the argument of enforcement bias. It is essential that a conversational level voice note be added to the recording from 3 feet to establish a reference level of about 70 dB(A). If a meter is used, add the time and sound pressure level to the recording.

### **Written Records**

The identity and location of an alleged violator along with the time and date of the event is vital. If sound measurements are made the levels and their location must be identified. Counterarguments about the ambient and reflections can be defended against. For more details on this issue see Data Collection below.

## Penalties

There are several types of enforcement penalties. Fines are fairly standard/ Jail time is also possible for repeat offenders. Confiscation of vehicles or their sound systems is also established in several ordinances. Some representative penalties are shown in Appendix F.

## Measurement Conditions

This section recommends methods to make accurate and defensible sound level measurements for those provisions that require them. The characteristics of sound level meters are given in Appendix E.

## Calibration

It is prudent to perform a meter calibration just prior to, and just after, measurements. Meter calibrations drift insignificantly over months so the primary purpose is defensive. The lesser atmospheric pressure at a higher elevation has an influence on meter calibration and should be taken into account.

## The Measurement Site

The site for measurement is often controversial. Those defending a violator would require the site to be such that a measurement would be within 0.5 dB of that measured in a free field (no obstructions or reflecting surfaces). Ground reflections will always exist for outdoor measurements, and other surfaces exist for indoor measurements so accuracy is always an issue.

Measurements for moving sources, such as motor vehicles, have been standardized by SAE codes (Appendix D), federal (49CFR325), or state laws. They are primarily intended to provide a “level playing field” for manufacturers to evaluate their products. This is NOT the intent of noise ordinance enforcement measurements; the listener is more important than the source.

For example, Connecticut restricts the site to a “soft site” or a “hard site”. The soft site must have grass or its equivalent for at least half the measurement distance, while the hard site must have asphalt or packed dirt for at least half the measurement distance. The ground must be relatively flat to avoid “focusing the sound wave toward the microphone”. They require traffic railings to have at least 35 percent of their vertical height to be open. There are other ground cover restrictions as well. The result of such restrictions is that the measured sound is a good indication of the *output* of the source in that particular environment. Having strict requirements of this type would sufficiently discourage an NCO from making any measurements and certainly would not further the aims of the noise ordinance.

Persons impacted by sound hear it *in situ* and measurements should reflect this fact. An argument by a potential violator is that the environment made the sound louder at the listener. The health and welfare criteria of an ordinance pertain *only* to what the listener hears, regardless of the site in which it is heard. It is important to remember that reflected sound is just another path from the sound source; it is **not** ambient interference. In any case, practical measurement sites can be chosen and the influence of reflections can be minimized by use of reasonable corrections. Errors created by sound reflections are greatest from large flat surfaces, such as



nearby buildings. Appendix C.5 shows the correction to be made by such a surface based on its distance from the microphone. Curved or smaller surfaces, such as vehicles, or mail boxes, scatter sound and have a small influence on measurement accuracy.

A non-environmental aspect for motor vehicle measurements is that sound output varies with speed and road grade. Strict measurement standards limit the range of these variables; however, reasonable corrections for them can be made. Posted speed limits are used to create speed categories. Most ordinances use 35 mph as a change in category and set maximum levels accordingly (Appendices B.1 and B.2). If the posted speed limit category is other than 35 mph, Appendix B.3 can be used to change the maximum levels so they are consistent with those set for 35 mph. Road grades can be an issue by defenders. The sound from a vehicle going uphill is indistinguishable from one accelerating (Einstein's Theory of Relativity). Creating separate categories for both these actions is important for manufacturer tests, but has **no** relevance to noise impact. To the author's knowledge no state grants an acceleration tolerance. Illinois appears to be the only state that grants a 2 dB tolerance for grades greater than 3 percent. Much vehicle enforcement is against obviously poorly muffled vehicles, so much of this discussion is relevant to only special cases. See the comments sections in Provision 10.1.

For non-vehicle outdoor measurements, such as those at property lines, the geometry is often complex but the measurement site should be taken as found. See Appendix C.7 for measurements beyond barriers. For indoor situations, measurements should be made where speech or sleep interference is likely. Again the measurement site should be taken as found. Hanging a meter out an open window is **not** recommended.

## Meter Height

The standard height for a measuring microphone is 4 feet. One reason is that it is at a convenient height for the person holding and reading it. It is also the approximate height of the ear of a seated person. In most cases, the level at the ear of a standing person is insignificantly different. This height applies to measurements at ground level, on a balcony, or at a window of an upper story. For ground level measurements, the ground reflection has a different path length so can cancel or reinforce the direct sound, particularly if the ground is hard. For a 50 feet distance, cancellation occurs in a narrow band around 900 Hz, while reinforcement occurs around 1800 Hz. The cancellation automatically applies a tolerance to the measurement, while reinforcement can be detrimental. Because most sources create sound at frequencies below 1000 Hz, any added amount to an A-weighted measurement may be insignificant. The only time that ground reflection influence may be significant is with a nearly pure tone between 1000 and 4000 Hz. Again, it is important to remember that any reflection enhancement is heard by the listener.

Connecticut permits height variations between 2 and 6 feet above the roadway for vehicle measurements and not less than 3.5 feet above the ground.

## Meter Distance

The distance of the meter from the sound source depends on the ordinance provision being enforced. For moving vehicle measurements, the standard distance is 50 feet, the distance between the microphone and the centerline of the travel lane. It is not always possible to be at this distance, particularly in urban areas where a property violation may occur. Since vehicle emission standards are based on this distance, it is useful and appropriate to correct the levels

measured at distances other than 50 feet to those that would have been measured at 50 feet. Appendix C.8 provides a table of corrections that can be applied to the measured level. For plainly audible measurements, the exact distance is provided in the ordinance

For land use and other property line measurements, some care needs to be taken. For a resident to have full enjoyment of his or her property, the measurement would normally be taken immediately past the property line, but that may not be the point of greatest noise impact.. One mitigation scheme is to add a solid barrier on the source side of the property line (much like noise barriers on highways). Since barrier height is very important, the question arises as to whether the barrier is adequate to meet the ordinance and where the greatest impact will be if it is present. Because the effect of the barrier on the A-weighted level depends on the sound spectrum, the barrier height, the distances of the source and listener from the barrier, it is not possible to provide a specific answer for every case. Simple models suggest that for a typical broadband sound spectrum with the source near ground level and with solid barriers from 6 to 20 feet high, the measurement should be made between 15 and 20 feet from the barrier (if beyond the property line) to minimize the impact of shadowing in order to get the maximum level. Appendix C.7 shows estimates of the sound loss created by the erection of a sound barrier. Colorado Springs, CO requires that measurements on non-public or private property to be made at least 25 feet from the property line of the source.

## Microphone Orientation

Direct-field microphones are designed to be pointed at the sound source. For a source near ground level the microphone should be nearly horizontal and facing the source (or the point where a moving source will be when the measurement is made). On occasion the microphone manufacturer may recommend a slightly different orientation to make frequency response more uniform. Random incidence microphones are the other type and should not be used if possible. Generally the sound spectrum is such that the difference in level between the two types is not significant.

## Measurer Position

The concern here is interference of the measurer with the meter reading. A tripod mounting with a cable several feet long from microphone to the meter is recommended for continuous monitoring. In that case, the person at the meter has negligible influence. In many cases, it is more practical to hold the meter. The person should NEVER hold the meter in front and facing the source; reflections can be significant. The meter should be held at arm's length facing at 90 degrees to the direction of the sound; microphone should be pointing at the source. Connecticut and Illinois *require* the meter (and measurer) to be remotely connected to the microphone by a cable to avoid measurer reflections.

## Meter Weighting and Response

The provision chosen in Provisions 10.1 determines the type of sound level meter needed. The measured sound level can differ from the actual instantaneous sound level in three important ways. A meter has “Slow” or “Fast” response; “Fast” collects and averages the sound pressure over a shorter time period than “Slow” (0.5 sec) making the measurement closer to the actual

sound level at any time. As a result, readings taken with “Fast” will vary more than those taken with “Slow” response, making it more difficult for an observer to decide a meaningful level. Slow response is recommended for the same reason; it adds an informal tolerance for rapidly varying sources. Fast response is used by some to capture the maximum of fast moving vehicles. Peak response is needed only for accurate measurement of impulsive sources.

Since actual sounds can cover a broad frequency range from subsonic to ultrasonic while the human ear has a more limited range, it is important to limit the frequency range of the measurement. Response of the human ear over the hearing range is not the same at all frequencies. Mid-range sounds (1000 to 4000 Hz) are heard much better than lower or higher frequencies. To account for this, *weighting networks* (Appendix C.2.3) on meters were developed. The one closest to the response of the ear is the A-Weighting network. There is a wealth of research based on this weighting network and there is a long record of its use in noise ordinance enforcement. It is also the one with which most environment noise data have been collected. A-weighting is recommended for the majority of measurements; the provisions should contain those requirements. There are some cases where C-weighting may be advantageous (bass from boom boxes

Some meters can display frequency divisions called *octave band* spectra (Appendix C.2.4). They provide more detailed information about the frequencies where the sound energy resides. Although such meters can be helpful in determining the characteristics of whistles or pure tones, they are not too helpful in noise ordinance enforcement, except for Alternative 5 of Provision 10.1 in Chapter 6). The meters are more expensive. Although there is a pure tone provision (Provision 9.2), tones are generally easy to recognize without a requirement to determine the exact frequency. Meters that have octave band filters are **not** recommended for most ordinance enforcement

## Ambient Conditions

When measuring a stationary source of sound, it is possible to correct for the presence of ambient sound using the methods given in Appendix C.3. If measurements have to be made with ambient interference, the ambient should be at least 4 dB(A) below the measured level.

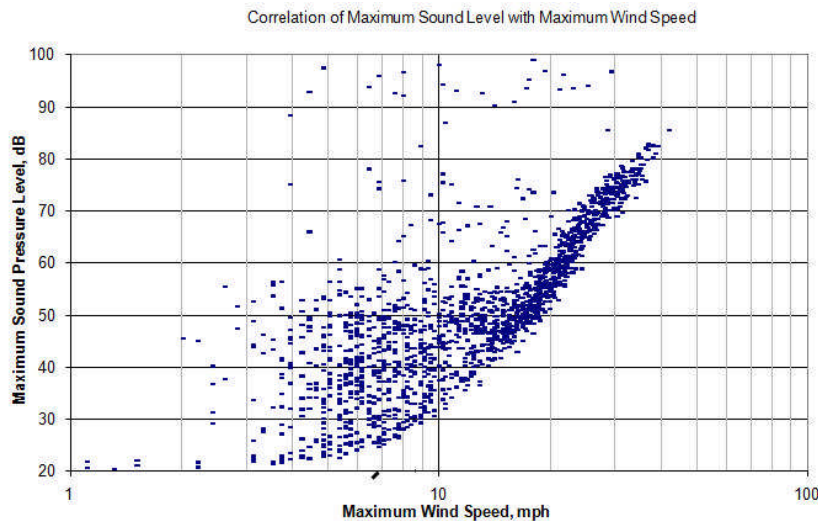
For vehicle measurements, Connecticut requires that the ambient be at least 10 dB(A) below the ordinance maximum levels. However, in most cases vehicle sounds are well above the ambient. On crowded roadways, other vehicles can contribute significantly if they are spaced too closely. See Section 10.1 below for details on this issue. Measurements should not be made during precipitation. Connecticut prohibits measurements when there is any precipitation or any standing water in the measurement area.

## Wind Speed

Wind is a non-sound (Appendix C.1) which microphones record as sound and *must* be eliminated. There are two aspects of wind noise. The first aspect is at the microphone; wind over a microphone creates pressure fluctuations that the meter interprets as sound. The microphone *must* be protected with a wind screen. These screens allow the sound to penetrate but damp out the air motion to a degree. The degree of protection depends on the screen design. A wind screen is most important when measuring lower sound levels. Manufacturers should provide data on the upper limit of wind speed for their screens. At and above the upper limit the

wind creates a non-sound instrument noise floor which must be treated as a raised ambient. Also, sound is created in the natural environment (trees, etc.) as a result of wind disturbance is actually a raised ambient.

A high quality monitoring microphone with a good wind screen was placed in a remote desert area for a long time; the results are shown in the Figure 7-1. It resulted in a graph of maximum sound level versus maximum wind speed during each hour. The lower right edge of the data spread indicates the relationship between the lowest maxima level and the wind speed. A wind speed of near 12 mph created a noise floor of 35 dB(A). This included both microphone wind noise as well as the sound from local vegetation. If the lowest maximum sound limit in a community is 45 dB(A) for land use, 12 mph is a good upper limit to wind speed;



**Figure 7-1. Effect of wind on microphones with wind screens**

it gives a 10 dB difference. Despite ordinances to the contrary, for motor vehicle maximum limits near 80 dB(A), *wind speed is not a factor under 30 mph*. The numbers in the graph are maxima, representing gusts. Since most observers do not have an anemometer, a simpler way to determine wind interference from those gusts is to listen with a set of earphones (most quality meters have an AC output).

Connecticut requires use of an anemometer; measurements must be made every 15 minutes and the wind speed must be 12 mph or less. Colorado limits wind speed to 5 mph.

## Reporting

Connecticut reports levels to the nearest whole decibel and allows tolerances up to 2 dB for reflections, wind, temperature, and atmospheric pressure (concern about pressure corrections needs to be made only at higher elevations). Accuracy to integer decibels is warranted (73 dB not 73.4 dB), and a 2 dB tolerance is recommended.

## General Enforcement Methods

### Education

Most citizens are not aware that a noise ordinance exists. Since almost all citizens travel in cars, street signs on major thoroughfares are a useful way to inform them of the presence of an ordinance. Many cities have prominently displayed signs similar to those shown in Figure 7-2 below. The upper left sign is used in the town of Jerome, AZ and is the recommended format. Its purpose is very clear. The author had to remove from the picture the word “NOT” to the left of “ENFORCED” that apparently had been added by a citizen irate about motorcycle noise. The middle sign is a useful variation displayed in Rifle, CO; the words are large and clear. The top sign on the far right is a variation intended to express concern about unmuffled motorcycle noise in Carefree, AZ by addition of the sound level limit. The first sign in the second row is not as helpful as the earlier signs. The small size of the lower middle sign is an indication of a city



*Figures 7-2. Examples of noise ordinance signs*

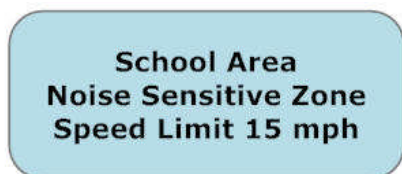
being pressed by citizens to enforce a noise ordinance but the council is fearful that the ordinance will reduce business. The last sign in Guelph, Ontario is definitely **not** recommended; it can be interpreted both ways.

In Burlington VT, property owners of rental housing are required by ordinance to furnish a copy of the city noise control ordinance to tenants at the beginning of the rental term. Some communities in the 1970's tried public informational seminars on noise. The subject is not one that attracts large numbers of citizenry so seminars are not generally successful. The best educational aspect is for a group of citizens concerned about a specific noise problem to educate the city council or county commissioners on the need for an ordinance. Articles about the pollution associated with noise in newspapers have a beneficial influence on citizens, but has the



potential to create more complaints to city officials. It is advisable in noise sensitive zones to make passing persons aware of the noise restriction. For schools it is advisable to combine speed and noise restrictions as suggested in Figure 7-3 below.

If there are shooting ranges in the community, a sign along roads nearby will alert potential home buyers to the possibility that noise impact may occur. Positioning the signs is critical. The sign in Figure 7-4 is recommended to be placed at close intervals around the perimeter of the facility to avoid severe noise impact and potential injury by trespassers.



*Figure 7-3. Noise sensitive zone sign*



*Figure 7-4. Shooting range warning sign*

## Data Collection

The data collected are determined strongly by the particular provision being enforced. Some general suggestions are:

- Identify the source of the sound. Names, addresses, license plate numbers. This can, and should, be done by any complainant as well as the enforcing officer.
- Identify the nature of the sound, particularly if it contains information such as speech or music.
- Identify the land use zoning of the source and the listener and property line locations.
- Determine whether the sound is man-made and out of the ordinary, or whether it is naturally caused (wind for example).
- Determine the times, and if at night determine how close to sleeping facilities.
- Determine the duration, and whether the sound is intermittent, or constant.
- Estimate, or measure, the ambient sound level if there is a possibility of interference.
- Estimate the distance from the source to the listener if the provision cites distances.
- Measure the A-weighted sound level if enforcement is of a numerical standard.
- Determine if any complainant wears hearing aids.

## Concern about Ability to Prosecute

An NCO must look at the information prosecutors want for a successful case. A survey in Florida developed the following responses from prosecutors:

- 54% agreed that previous warnings, or past problems were important.
- 38% stated the level of noise was important. (dB level)
- 38% stated that the elements of the ordinance must have been met.

- 38% needed to know the number of victims/witnesses present.
- 23% stated that the area of the complaint was important, residential or business.
- 15% said that the time of day of the violation was important.

The survey also concerned training of enforcement officials:

- 69% stated that documented training would be beneficial.
- 31% responded that training would be of no help.

## Soft Fuzz

The word “Soft Fuzz” was first applied to noise enforcement in Boulder, CO. In that program a violator (called “a customer for quiet”) was given every chance to come into compliance without an immediate penalty, whether a vehicle or a stationary noise source. In essence, it was an attempt to encourage immediate and voluntary compliance. A large percentage of violators complied within a reasonable time. Since many of the violations were based on complaints about stationary sources, compliance was estimated by the lack of later complaints. Most violations for vehicles were due to inoperative or modified mufflers. The offender was issued a citation and was directed to pay the fine or spend the fine money on muffler replacement prior to the court date. The court was requested to dismiss the case if a subsequent test met the ordinance. A caveat was that if a second offense occurred, the first fine as well as the second was to be paid. The obvious purpose was to quiet the city and not use enforcement as a money maker. Court use was reduced.

California’s Motorcycle Anti-tampering Act of 2010 forgives citations if the vehicle is brought into compliance in a timely manner.

## Warnings vs. Citations

Warnings are generally effective for accidental offenders so are cost effective for the community. They are ineffective for repeat offenders. Warnings, either verbal or written, are useful for complaints about both stationary and moving sources where it is difficult for an NCO to establish a violation. It will eliminate further NCO activity for offenders that do comply. Cumulative fines for multiple violations are the norm (See Appendix F). Imprisonment or jail sentence is not generally applied to noise violations. Many communities give violators a reasonable time to comply, particularly stationary sources (e.g. air conditioning units). The time to comply can be given by authorized variance or unofficially. Columbus, OH issues of a warning for violation of stationary noise sources that must be complied with within 12 hours.

## Complaint Response

This method can be called *passive* enforcement. Much of it is subjective, such as establishing that a “noise disturbance” has occurred, and is based on complaints. Loud parties, loud radios, and barking dogs are a few examples. How many complaints are required to establish a violation? It is always necessary to establish that the complainant is a reasonable person with normal sensitivities and that the complaint is based on acoustics, not neighbor antipathy. If the sound is sufficiently continuous, it is possible for the NCO to establish the reasonableness of the complaint by acting as a second complainant. Tape recording establishes



the character of the sound and is useful in court. Some communities require more than one complaint about a noise disturbance to separate out antagonistic persons. It is not always successful for several reasons. All surrounding neighbors may be sufficiently upset with a neighbor so that noise is a minor aspect of their dislike, or they may be reluctant to voice their objection.

Whenever regional developments occur requiring change in the local environment, noise is almost always one of the NIMBY (not in my backyard) factors. Although many may be vocal, it may be difficult to get other people to speak up because of fear, despite being disturbed, so it may be difficult to assess the magnitude of the impact. It is recommended that the NCO be present to establish the presence of a violation and determine the number of people adversely affected.

The distance at which a remote conversation can be understood (plainly audible) can be determined easily. One aspect of this is speech interference inside a residence. Speech interference can also be used to estimate the level of intruding sounds *without* a sound level meter. (Appendix C.6). During night hours the potential for undisturbed restful sleep should be evaluated by interview.

When the complaint is “unreasonable” or “excessive” noise, the subjective aspect needs to be buttressed by a number of considerations:

1. The source of the sound.
2. The sound level, if measured.
3. The ambient level, if measured.
4. The duration.
5. Whether continuous, intermittent, or impulsive.
6. The time of the day.
7. The zoning district of the listener.
8. The proximity to sleeping facilities.
9. The number of complainants.

## Inspections

Authority to inspect premises for actual or suspected noise sources can be a powerful noise control tool. Generally, search warrants are required for private residences, however. Delaware permits officials of their Department of Natural Resources and Environmental Control to act in this manner without a warrant. Hawaii also permits inspections at “reasonable times” but does not mention special conditions for private residences. Denver, CO (Sec 36-4) and Harford, CT (Sec 23-6) have well written sections on inspections.

## Penalties

Penalties can be effective enforcement tools. In most communities, noise violations are considered a misdemeanor and thus the magnitude of the penalty is limited. Some communities have escalating fines for subsequent offenses. Some existing penalties are shown in Appendix F.

## Confiscation/Impoundment

. In certain cases, a facility can be closed or a noisy product can be confiscated, creating an immediate economic impact on the violator. Wisconsin permits communities to impound sound devices, but only if the violator has had two or more convictions within a three year period. They also permit impoundment of vehicles for not more than five working days in order to remove any sound making device. Colorado Springs, CO permits sound system confiscation for a third offense. For more discussion of confiscation see Section 4.8 in Chapter 4.

## Restraining Orders

For continual or recurring violations of the noise ordinance, officials may seek temporary restraining orders or permanent injunctions from appropriate authorities. Albuquerque, NM permits restraining orders for noise violations.

## Licensing and Labeling

Some communities use licensing to restrict the use of products that have been determined and listed to be excessively noisy. Labeling acts to inhibit alterations that increase sound levels. Kentucky prohibits removal of labels prior to sale.

## Permits

A number of communities require that anyone wishing to install and operate a public address loudspeaker must first apply for a permit from the community. Richmond, CA and Albany, NY require permits for outdoor sound systems.

## Handling Plainly Audible Violations

Provisions with “plainly audible” are used to identify sounds that can be identified simply by listening, so a sound level meter is not needed. It is more objective than the noise disturbance provision (Article VI), but less objective than the sound level limits in Articles IX and X.

Some of the recommended procedures are as follows:

- If the provision being enforced has a required distance, it should be listened to there. If in doubt, move further away, intelligibility does not decline rapidly at distances greater than 50 feet. For private property the distance is to the property line.
- If there is a required distance, there should be a direct line-of-sight at the correct distance between the source and the NCO. If a line-of-sight is not possible, move closer until a line-of-sight so it is possible to verify that both sounds are the same.
- Normal hearing by the NCO is required. No listening devices may be used.
- The source should be clearly identified
- It is not necessary to understand particular words for voices, only the fact that it is a voice.

- The type of sound should be identified. It is not necessary to understand the words of a song or the rhythm of music, only the fact that it is musical. Identification of bass sounds is sufficient.

## Enforcement Methods Specific to Each Provision

There are two basic methods of enforcement: active and passive. In some communities active enforcement is done by an NCO setting up a sound monitoring station along a roadway, much like speed monitoring. The choice of location is the NCO's and the ordinance provision being enforced is almost always an objective one with a numerical standard. However, most enforcement is passive, i.e., based on citizen complaints. Typically, a call is placed to the dispatcher and passed to the NCO for response. The applicable ordinance provision can be either subjective (loud party or barking dog) or objective (loud vehicles). The details of enforcement are determined by the specific ordinance provisions. Discussion of enforcement methods for the each of the provisions listed in Chapter 6 are given below.

**Most of the discussion below is technical as opposed to social or political. The author has not had experience with enforcement of all the provisions so some comments are limited to general discussion.**

## Article VI NOISE DISTURBANCE PROHIBITED

The enforcement is totally subjective and is based on one or more complaints. A sound level meter is not always required, but a measurement of level can be used for comparison with levels that adversely influence citizen health and welfare. This provision is often used when the provisions of Article VII, IX and X are difficult to apply. When this happens, the enforcement has more social and political aspects than technical aspects so no detailed recommendations are offered for this article.

## Article VII SPECIFIC PROVISIONS

### 7.1 Radios, Television Sets, Musical Instruments, and Similar Devices

Normally, official response is based on complaints. This provision applies to *amplified* sounds **not** intended for others in properties other than the source. The signal amplified can be anything from a voice, a song, or music. Generally the sound is from stationary sources such as homes. There can be an overlap with *unamplified* sounds such as voices at a loud party. The recommended provision does not require use of a sound level meter. The term “plainly audible” has been established as a partially subjective enforcement tool (see page 7-12) against intelligible sounds. The term “noise disturbance” has also been established as a totally subjective enforcement tool against other sounds and might require several complainants as well as observation by an NCO. Curfew hours and distances are readily determined. Police are very experienced in handling these events. The violators generally quiet down (at least temporarily)

when the Article VI noise disturbance provision is used in addition to this provision (despite the fact that the provisions overlap). One difficult issue is access to, and identification of, the device making the sound when there is resistance. Access capability is determined by other laws. Columbus, OH requires a search warrant to inspect the source of the sound if entrance is denied by the operator. Some communities hold all attendees at a loud party legally responsible. Some ordinances permit confiscation of the devices. See the discussion on this issue in 4.8 of Chapter 4.

A place of entertainment may have a music system that addresses customers in an outdoor patio area so this provision and Article IX is applicable to it. Provision 7.9 of Chapter 6 addresses places of public entertainment, but addresses the noise impact on the persons within the facility.

## 7.2 Public Address Systems

Normally, official response is based on complaints. This provision applies to *amplified* sounds intended for others within the source property, in surrounding properties, or in public property. The speakers are generally outdoors but they may also be indoors with open access to the outdoors. The issue is that the sound is louder than normal. In most cases the sound level is determined by a power amplifier. The addition of the term “similar device” includes a megaphone, but not a raised voice. Although the sound of a car dealership may be intended for employees within the property, it is the sound emitted beyond the property line that is the focus of this provision. The signal amplified can be anything and is generally from a stationary source, although there are prohibitions against sound from sound trucks and low flying aircraft. The provision is separated into commercial sound and non-commercial sound parts to avoid Amendment I problems (free speech). Curfew hours are applied to commercial sound, but not non-commercial sound. A sound level meter is not needed. However, its use is needed if the NCO takes advantage of the additional tool of Article IX for sound across property lines. The term “plainly audible” has been established as a partially subjective enforcement tool (see page 7-12) against intelligible sounds. The term “noise disturbance” has also been established as a totally subjective enforcement tool against other sounds and might require several complainants as well as observation by an NCO. A sound recorder is helpful to establish the character and duration of the sound. Although not included in the recommended provision, a permit may have been added to the provision or made policy for communities where outdoor sound systems are common. This provides an additional enforcement tool. Many cities require permits for any outdoor commercial or non-commercial public address system.

## 7.3 Street Sales

Normally official response is based on complaints. This provision addresses commercial sales using the *unamplified voice*. The use of a megaphone may or may not be included. The more subtle issue is determining whether an ice cream truck with bells or chimes is considered part of an “outcry” or is covered as part of a commercial sound system of Section 7.2. A sound level meter is not needed; a loud voice can be readily determined. The land use zone needs to be determined and whether a permit may be required. Curfew hours and permits are standard controls. Farmer’s markets generally do not result in outcry.

## 7.4 Animals

Normally, official response is based on complaints. Barking dogs probably are the most pervasive noise problem in suburban communities. Barks are repetitive, impulsive sounds. The impulsive nature can create a startle response, and the levels can be much higher than most land use sound limits in Article IX allow. Most neighbors will accept only a few minutes of barking. Although a sound level meter with a peak level detector can capture the maximum sound, the person with the meter is only rarely available during the event and it is unlikely that the meter is capable of detecting peak sounds. Since suburban ambient levels are low, barking can be heard at long distances. Identification of the animal is generally not an issue even if there are multiple animals as most animal ordinances require fencing or leashes. The recommended method is to ask the complainant to keep a record of on/off times to establish when, how often, and what percent of the time the event occurs. They have been asked to photograph the animal to identify it. Photos may be applicable to free animals but not to fenced animals. In almost every case, photographing incites the animal to make further sound. Many neighbors attempt to resolve the problem directly, but like complaints about another's child, denial is the most frequent response, sometimes followed by retaliation. In some communities, the animal control officer must experience the event to eliminate neighbor bias. In others, a second complainant is needed to establish that no personal bias exists. Animals that are left alone behind a fence for long periods of time, or left free are sometimes taken to the local animal shelter. Otherwise, the owner is given a warning. Animal control officers often try to assist in resolution by recommending that the animal be kept indoors during periods likely to provoke barking or interfere with neighbors sleep. Muzzles or a barking control collar are recommended for repeat offenders. Second offenses are recommended to result in a citation with escalating fines for subsequent violations and a threat to have the animal removed.

In most cases a sound recording by the complainant or the NCO will establish the identity of the animal. To establish approximate levels, a vocal notation should be added to the recording at conversational levels from 3 feet. That level is about 70 dB(A).

The sound from animal shelters and that from the more recent animal resorts, where animals are boarded while the owners are absent, can result in complaints more difficult to resolve, since it is a land use planning failure and an economic issue. Sound from other animals, such as exotic or farm animals (roosters) are a rarer source of complaints and no enforcement recommendations are presently available.

Although barking dogs may be good watch dogs, community responsibility for the neighbor's peace and quiet overrides it. Some recommendations for an NCO to help owners reduce dog noise impact are:

### **Bring the Dog Inside**

This action is the most effective method of reducing noise to neighbors. It is also a good way to avoid a citation. Dogs staying outside tend to respond to local events especially during early evening or night hours. If the owner responds immediately to any barks, the dog will associate his bark with the owner's alarm and reducing response will reduce the number of barks.

### **Install an anti-noise collar or other device**

Another step is to Pavlov train the dog with a device that provides a slight shock in response to loud sound. Other variations are an ultrasonic frequency generator that can only be heard by the dog and which is activated by a loud sound.

### **Regular leash walks**

Provide the dog with mental and physical stimulation. Interact with him regularly

### **Discipline the dog**

Give him a short blast of water at the body with a squirt bottle if there is too much barking. When he stops making sound, praise him immediately.

### **Provide a chew toy**

The dog will have a hard time barking if his mouth is busy chewing. Chewing is a natural stress release for animals and an occupier of time.

A recommendation noted on the **barkingdogs.net** web site states:

Whenever an employee of either the Sheriff's Department or the Department of Animal Regulation receives an initial complaint that a dog's voice is being projected into human habitat or a place of human occupation, an officer from the Sheriff's Department will be dispatched with all due diligence to inform the dog owner of the complaint. The officer will then require said dog owner to either confirm or deny that the animal is barking.

If the dog owner acknowledges that the dog has been barking, a ticket will be written.

If the officer personally does not witness the dog barking and the owner denies that the animal's voice is being projected onto neighboring property, at that point, a behavioral assessment to test the dog's propensity to vocalize will be conducted.

If the behavioral testing fails to demonstrate that the dog's vocal behavior is problematic, and up to that point the investigation also has not shown that the dog's voice is being projected into the complainant's dwelling or place of occupation, either as a regular event or as a predictable occurrence, the complainant will have the option of personally retaining private security personnel - deemed credible by the Sheriff's department - to survey the property in the shortest possible time frame, and provide personal testimony as well as video or audio documentation to establish that the dog's voice is being force-fed into the complainant's home or personal space as reported.

If the surveillance substantiates the complaint, the dog owner, who's false denial made the monitoring necessary will be fined. He will also be billed by the county for the cost of the surveillance and the amount will be forwarded to the complainant as reimbursement.

Once the continuing barking problem has been substantiated, the dog owner's dog license will be immediately placed on probationary status.

From the start of the probationary period, the dog owner will have twenty-one days to quiet his dog or dogs.

## 7.5 Loading and Unloading

Normally, official response is based on complaints. Sound from these operations can be from the idling vehicle as well as the activity itself. The vehicle should be turned off after the time period specified in Provision 10.11. The variety of possible noisy operations is large, so it is impractical to control the sound output by an *emission* control, so only a subjective control (noise disturbance) was recommended. Site planning is, of course, the optimum control. The recommended control is strict enforcement of curfews. Article IX might be used for this activity; the value of this provision however is that it gives the potential violator fair warning that excessive sound from his activities is not acceptable. Article IX requires sound level measurements. Sound barriers can be erected on the source property to mitigate the effect, but specific recommendations to a potential violator should **not** be made. See C.7 in Appendix C.

## 7.6 Construction

Normally, official response is based on complaints. Enforcement depends critically on the type of construction and when it is being done. Weekday and weekend limitations, if included in Provision 7.6, make enforcement straightforward. Note that Alternative 1 does not require a curfew but a limitation of impact during restricted hours and a limitation on how much of the hour the maximum level might be exceeded. Alternative 2 has no restriction during daytime and extends the provisions of Article IX to classify a construction site as an Industrial Zone during night hours. Sound level measurements are required for these alternatives.

The control of larger projects is dependent on whether Provision 4.7 of Chapter 5 was in the ordinance. If so, the NCO can review a proposed project prior to activation for potential noise impact on surrounding areas. If Provisions 5.4. And 5.5 of Chapter 5 were in the ordinance the construction is required to meet all provisions of the ordinance. In that case, enforcement is relatively easy to define through use of Article IX.

Complaints during residential construction often are about loud music from contractor vehicles or radios on site. That is best handled by Provisions 10.5 or 7.1. Air compressors are another source of complaints because they operate continuously. If authorized, the NCO can make on site measurements of the compressor to determine whether it meets the requirements of 40 CFR 204. That law requires levels to be 76 dB(A) at maximum rated operation when measured near 25 feet (7 meters) over a flat surface. If Provisions 7.8 and 10.6 are part of the ordinance, the NCO can measure the sound output of the products in use on the site as a form of *emission* control

Experience suggests that reduction of noise impact is a cooperative activity. The contractors can alter their mix of equipment so that the noisiest units (e.g., pavement breakers and pneumatic drills) are used in midday. If backup alarms are a source of complaints, suggesting a change to a different alarm would help. See Comments in Provision 7.6 of Chapter 6.

Erection of noise barriers is sometimes suggested. Solid fencing around sites for security is seldom effective enough. Effective barriers would have to be quite high and properly placed. Their erection would be resisted. The first questions from the contractor would be where and how high, so responsibility is passed to the NCO.



## 7.7 Motor Vehicle or Motorboat Repairs or Testing

Normally, official response is based on complaints and most are about high RPM engine sound. These activities can be conducted in residential zones and can be especially loud, so the sound from them warranted separation from domestic power tools as noted in Provision 7.16. If Alternative 1 is in the ordinance, only a curfew is enforceable. If Alternative 2, subjective enforcement of noise disturbance is applied during the day and a curfew is applied at night. The purpose of this provision was to provide *fair warning* to the persons doing the repairing, since Article IX can also be used as an enforcement tool. Enclosing the vehicle within a garage or other structure *that can be closed* is one method of noise reduction.

## 7.8 Airport and Airport Operations

Normally, official response is based on complaints. There are several occasions that result in complaints: landing and takeoff events, low flying aircraft, and outdoor engine testing. There has been successful litigation over the second item (see 4.6.1 in chapter 4), and communities can have some control over the latter item (see the Existing Provisions section of Provision 7.8 in Chapter 6). Most airport operations are difficult to control without compromising federal law. Working with the operator and the FAA is the best recourse. Overflying aircraft are a difficult problem: technically they are not in the community. Aircraft numbers are needed to identify them and since they are quite small, they are difficult to read. If they can be read, they should be reported to the FAA since it is likely they are flying below the minimum altitude permitted by federal law. Although not included in the provision, it is possible to restrict outdoor engine testing such as Albuquerque, NM does. The resolution of aircraft noise impact on a community is so complex that it is beyond the scope of this document to address.

## 7.9 Places of Public Entertainment

Normally, official response is based on complaints. In most cases the complaint is from residents of the nearby community, not persons in the facility. Although enforcement of those complaints is with Provision 7.2 or Article IX, the complaint gives the NCO probable cause to enforce this provision. This provision is related to the levels that affect customers and entertainers. It is unpopular with the management, the entertainers, and most of the customers. Alternative 1 is a low cost way for owners to avoid interior measurements by the NCO, but still opens them to Article IX enforcement. The signs must be located in a conspicuous location. Informing management of complaints from nearby residents may convince them to voluntarily reduce sound levels. Enforcement of Alternative 2, in practice, is a set of measurements by the NCO to indicate what amplifier settings are acceptable. They must be made at reasonable positions inside the facility and not on any outdoor areas as Article IX violations would be likely to occur. If the level recommended in Provision 7.9 is in the ordinance, a violation occurs if the slow A-weighted level *at any time* exceeds that level. Since it is most likely music, a counter argument is that the levels change from minute to minute so exposure varies. The response would be that the levels in the ordinance are well *above* long term maximum exposure levels and so are enforceable.

## 7.10 Impulsive Sources, Explosives, Firearms, and Similar Devices

Official response is based on complaints due to noise disturbance. Enforcement of this section does not apply to authorized shooting ranges (see Provision 7.19 of Chapter 6 and state law), but does apply to informal shooting ranges that local residents may establish. The curfew in the first section is vital; any impulsive sources at night create very strong negative community response and may also be dangerous. Since this provision covers impulsive sounds and the startle reaction, it encompasses a wide range of sound sources. Blasting is sufficiently serious that use is generally allowed only by permit and with adequate warning signs. The discharge of firearms is clearly a noise disturbance, but other sources are more difficult to enforce. With regard to firearms, enforcement of *unlawful discharge of firearms* may be involved. This provision also applies to fireworks; how many firecrackers are needed to create a violation? Do they create a local fire hazard? Dog barks are impulsive but are covered in Provision 7.4. The recommended criterion for enforcement is to use the section on common questions about sound (page 3-11 of Chapter 3). Does the sound frighten listeners, or suggest any danger to them? Is it unnecessarily repetitive? Since impulsive sounds have high peak levels, they can carry a long distance and cover a wide area, making it possible for distant complainers to cite disturbance or annoyance even though the intrusion is of low level. Although Article IX (Provision 9.2) may be applied, the transient nature of most discharges requires detection of levels during the time of the event, which makes it difficult to enforce that way. If this issue is important and continuous, a meter with a peak level detector should be purchased and the ordinance modified to insert maximum impulse levels, such as shown in Table 6-6 of Chapter 7.

## 7.11 Powered Unmanned Vehicles or Engines

Normally, official response is based on complaints. Alternative 1 allows free operation during permitted hours while Alternative 2 allows for noise disturbance during permitted hours. Curfew enforcement is straightforward. Level enforcement is more difficult so no maximum sound levels were recommended for this provision. The sound output of the vehicles can vary from that of a small electric motor driven propeller to that of a small jet engine, and the distances will continually vary with the vehicle in motion, so an objective measurement is difficult to defend. Small aircraft can be up to a mile from the person directing it and several thousand feet high, while rocket launches tend to be directly above the launcher. Reasonable application of the definition of noise disturbance is recommended during permitted hours of operation. Note that the provision does not restrict the operation to any specific type of property. If sound from these vehicles is a continual problem, consideration should be given to restricting use on public property, except perhaps by permit in designated areas. Article IX is a possible addition to enforcement of this provision.

## 7.12 Vibration

Normally, official response is based on complaints. Alternative 2 added a nighttime curfew to Alternative 1; curfew enforcement is straightforward. The recommended provision avoids the need for specialized equipment to measure vibration. Unlike sound, the enforcement problem is identifying the source; it is sometimes difficult. In one application, items on the fourth floor desks of a large office building visibly vibrated. There were no sources in the

building and the building was located on a large lot. It occurred only when there was much rain. It turned out that with rain the soil became so liquid that it transmitted vibration from a nearby power generator. Vibration generated within the complainant's residence is sometimes not identified by them and is obviously not subject to enforcement. Vibration transmitted in a multi-use facility may require detective work. Neighbor activities or poor isolation in mechanical equipment rooms may be the cause. Permission for inspection may be required. In most cases, vibration by touch can only be sensed at frequencies below 100 Hz. Vibrational motion of objects is obvious. Vibration will cause response in building surfaces, resulting in low frequency sound that can be heard. Conversely, a low frequency sound source may **not** cause vibration above the vibration perception threshold so it cannot be enforced under this provision. All of these factors can be a cause of complaint.

### 7.13 Stationary Non-Emergency Non-Safety Signaling Devices

Normally, official response is based on complaints. Curfew enforcement is straightforward. Timing the period of operation is all that is required. That can be done manually or with a sound level meter capable of recording events. Since this provision is an *emission* control, distances and property lines are not relevant, however, Article IX also may be used. The sticky issue is the source. Cultural (social) issues arise with clock chimes that may have sounded for years. Some sound every quarter hour and may be electronically amplified; the recommended time limit would restrict it to once an hour. Religious issues create more difficulties. In older more rural, homogenous, communities with low ambient levels, church bells have been traditional. They have little place as calls to worship in modern urban societies since background levels restrict the area of audibility. Proliferation of religious groups and their churches in suburban communities can create a cacophony of church bells if all were permitted to sound freely. Enforcement of the recommended time limit keeps some cultural value without excessive impact on the nonreligious. A more difficult enforcement issue is the amplified Islamic call to prayer five times a day. Offense is easily taken when permission for the call is restricted by nonbelievers. There are two problems. Mosques traditionally have loudspeakers high on the tower set at high levels that cover very large areas. The second is that traditional calls can last up to 15 minutes. However, there are many calls that can be voluntarily restricted to the recommended time, so reasonable enforcement is defensible.

### 7.14 Stationary Emergency Signaling Devices

Official response can be based on observation and internal controls, as well as complaints. Curfew enforcement is straightforward. The time required for testing is likely to be variable depending on the device being tested, but the value of the time limit recommended is normally longer than that required. It is recommended that enforcement of the audible fire alarm time limit be variable. Audible burglar and security alarms tend to be relatively ineffective. Burglars know about how long they have once it sounds and neighbors are mostly reluctant to get involved, except possibly calling the police. Now, most fire and home security systems are silent and connected to a monitoring company for transfer to the police. Audible systems that have numerous false alarms can be strictly enforced by other ordinances.

## 7.15 Noise Sensitive Zones

Official response can be based on complaints or requests for selective monitoring. Although the ordinance may contain a number of facilities in the definition, enforcement needs to vary with the specific facility. One of the difficulties of enforcement is that the extent of the zone is seldom defined. It can be interpreted to be the property boundary of the facility, in which case a street vehicle is outside the zone. It can be interpreted to be a more extensive area that is difficult to define defensively but marked by appropriate signs. The offending sound can be from a stationary source, such as an adjacent neighbor, or a moving source, such as a horn blowing motor vehicle. Article IX can be used for stationary sources. Proper land use planning would have prevented the problem. Complaints about motor vehicles would require periodic monitoring and enforcement of Article X. In the comments on Definition 3.30 of Chapter 5, it was recommended that the list be minimized, since most standard facilities for inclusion are now built with high sound attenuation and adequate property so there appears little need to single them out for special attention. Hospitals are faced with helicopter sound, so a defense argument by a violator is that their sound was considerably less. Most modern churches are set on their own property, especially in suburban areas, and are not particularly noise sensitive except possibly on Sunday mornings. Retirement homes and similar facilities are generally located in residential zones so Article IX can be used. Most modern schools are set on property where the major noise source is the children themselves. In communities with schools on major streets enforcement is desirable. Adding a noise sensitive sign to the vehicle speed restriction sign should help to reduce local sound levels. See the Education section above. One method of reducing the difficulty of enforcing noise sensitive zones is to reroute heavy trucking. Although interstate commercial truck sound levels are mandated by the federal government, communities can assign truck routes away from these zones, but not on the basis of noise. Enforcement of the dynamic brake provision (10.13 in Chapter 6) is another method of reducing noise impact in these zones.

## 7.16 Domestic/Commercial Power Tools

Normally, official response is based on complaints. If alternative 1 was chosen, curfew enforcement is all that is required. If alternative 2 was chosen, the NCO can use subjective enforcement during permitted hours. Note that vehicle engine sound is covered in Provision 7.7. Although not included in the recommendations, the ordinance may single out specific devices for enforcement. Gasoline powered leaf blowers appear in several ordinances. Portland, OR has a unique way of handling leaf blowers. The NCO is required to make a list of products that do not exceed 65 dB(A) at fifty feet and a list of products that do not exceed 70 dB(A) at 50 feet. If the leaf blower is not on the list, the product is in violation or must be tested. See the Existing Provisions section for this provision in Chapter 6. Because complaints are likely between neighbors, recommendations on tool location (indoors), continuity of use (minutes per hour), or time and day of use (weekday mornings and not on Sunday) may avoid citations. No recommendations can be made for ordinance provisions that are more detailed than that in Provision 7.16. Article IX is also available as an enforcement tool but it requires a sound level meter.

## 7.17 Air Conditioning, Heating, or Pool Equipment

Normally, official response is based on complaints. The intent of the recommended provision was to avoid having to make sound measurements. Although manufacturers have reduced sound output of their products, land use arrangements still can result in complaints. Often a person with an open window (no air conditioning) will complain about the sound from a neighbor's air conditioner. The same applies for pool equipment. Because of the wide variety of equipment, it is not practical to have an *objective emission* control, although several communities have done so (see the Existing Provisions section in Chapter 6). Roof top units can project sound to all floors of a neighboring apartment building, creating widespread annoyance and complaints. Short of specifying sound power output of these units, *subjective immission* control is the only practical approach. Since it would be difficult to justify shutting the equipment down, it can be moved to a new location or contained within an enclosure or barrier to reduce noise impact. The NCO must **never** give specific recommendations on how this might be achieved. If sound reduction is achieved, it still might not be enough for the complainant ("I can still hear it"). The maximum sound levels of Article IX might be used as a criterion for reasonable acceptability.

## 7.18 Tampering

Normally, official response is based on complaints and requests for monitoring. Enforcement of tampering can be difficult. In most cases, monitoring detects a vehicle that is in violation of Article X and tampering becomes an additional violation. If the vehicle is stopped to issue a citation, inspection of the muffler will show whether it has an EPA label or not; most will not. Federal law (40 CFR 205) requires EPA certified mufflers and labels on at least motorcycles and off-road vehicles. Without a label, tampering is likely. Tampering is obvious if the muffler is a straight pipe. If the measured sound from the muffler appears excessive, was it caused by the replacement or by simple performance degradation over time? It is necessary to separate performance degradation from intentional or accidental "tampering". If the violator went to a muffler shop he or she may not be aware of what the new muffler was. Was he guilty of tampering or was the shop guilty? Owner onus may play a role here (See 4.1.1 in Chapter 4). To reduce the complexity of enforcement, the third part of the provision acts as a preventive measure and places the onus for compliance on those shops that modify mufflers. Although not included in the provision is a part requiring labeling that provides visual evidence of compliance. {NOff} has a section on Label Matching Programs. The difficulty for the NCO is in determining whether the measured operational sound level is higher than that of the original equipment and was caused by a normally performing replacement. See Section 10.1 below and the comments section of Provision 10.1 in Chapter 6.

## 7.19 Authorized Outdoor Discharge of Firearms

Normally, official response is based on complaints and result in monitoring of the site. State law should be consulted as most states grant exemptions for licensed shooting ranges or may have specific operating restrictions. If the site is unauthorized, Provision 7.10 or Article IX is applicable, depending on nearness of residential areas. If the site is authorized, Provision 7.19 applies and enforcement is constrained to curfews and negotiation with the range manager to

limit sound output with barriers, reduced frequency of activity, and limiting the size and type of weapons allowed. See the comments section of Provision 7.19 in Chapter 6. Range operators should have boundary warning signs; see the Education section above and should report any unauthorized persons in the facility.

## 7.20 Apartments and Condominiums

Normally, official response is based on complaints. Often apartment or condominium residents are not particularly compatible, resulting in noise complaints. Enforcement is often a mediation (social) event rather than a technical event. High quality apartments have high amounts of sound absorption, with the possibility of noise disturbances occurring at very low sound levels (similar to the dripping faucet problem). At the other extreme, the sound attenuation of the building can be so deficient that even a reasonable sound output can generate complaints. For example, solid concrete structures can pick up sound and transmit it to other spaces with great fidelity. Shoddy workmanship can result in walls that transmit considerable sound. Open windows are not considered deficient construction. The first enforcement step is to determine whether the sound source is excessive or the building is deficient. Unfortunately, correction of a deficient building is not within the authority of an NCO, nor is forcing a person using a TV, sound system, or radio, at reasonable levels to turn their equipment off. Although closing a window helps, complainants are unresponsive to such a request, particularly during the summer with no air conditioning system. The NCO becomes a mediator at best.

Many times it is the nature of the sound (Why does he play that type of music all the time?) that is more important than the actual received level, so enforcement by objective sound level measurements may establish that a violation exists, but may not always solve it socially. Continual beating of drums, loud stereos, parties, and family arguments are obvious cases where measurements are not needed. Another particular, but rare problem, is related to nearby power transformers that radiate 120 Hz sound. That frequency has a wavelength a little over 9 feet not greatly different from the dimension of rooms. Disturbing resonances can be set up. Some communities specifically exempt power transformers to avoid this problem as well the outdoor noise impact. Condominium pool parties or noisy children in the common area can be enforced defensibly with this provision. The recommended provision is subjective

The recommended provision is subjective with Alternative 2 adding a curfew that makes enforcement much easier. Subjective enforcement depends on the judgment of the enforcing officer while many communities apply objective measurement standards (See Comments and Existing Provisions sections in Provision 7.20 in Chapter 6). The problem with objective measurement standards is that resident annoyance is determined by how much the intruding level is above the normal ambient level and how often the intrusions occur. When the intruding level is just above the existing ambient, many residents have employed a sound masking generator to cover up the intruding sound. Masking covers up other environmental sounds, including those that might be violations of Article IX. Since the annoyance levels are relative to the ambient, fixed sound level limits are not really effective. Objective measurements may take up to one hour.

The recommended first enforcement step is using the plainly audible part of the provision. It is less subjective than noise disturbance. The only exception to that is when the sounds do not contain meaningful information. The second step is to use the noise disturbance part. To keep enforcement from being unreasonably strict, a speech interference criterion should



be used in the complainant's rooms. Many complaints are based on interruption of speech, theirs, TV, or radio. They expect to be able to speak or hear at conversational levels. It is one of the justifications for a noise ordinance (See Speech and Audio Interference in Chapter 3). To determine the level of speech interference, the guidance in Appendix C.6 should be used.

## **7.21 Stadiums and Outdoor Music Festivals**

Official response can be based on monitoring as well as complaints. Alternative 2 adds a curfew and Alternative 3 adds an exception to Article IX to allow for higher sound levels. Unfortunately, the sound from these events can have more social and political aspects than technical. Successful enforcement of this provision requires the support of city officials. Shutting down a music festival that refuses to comply can have serious repercussions on the city administration as well as on the NCO. Observation of the loudspeaker array prior to the event provides a clue about the potential sound output of the system. The operators should be made aware of the ordinance provisions and the fact that monitoring will occur during the performance. In some cases, sound tests were run. Monitoring in the most sensitive area resulted in system adjustment to meet the ordinance provisions.

If the operators are exempted from the ordinance provisions by permit, the NCO (and city officials) will receive a bad grade from the surrounding community.

## **7.22 Funerals**

Official response can be based on complaints prior to, or during, the event. Enforcement is primarily using the plainly audible requirement (page 7-12) with an added distance requirement. Since this issue has more than sound issues, more officials than the NCO are required.

## **7.23 Wind Turbines**

Official response can be based on complaints. Unfortunately, once a wind turbine farm is installed, it is highly unlikely that any noise control is possible. The physics (sound) of rotating blades is difficult to change. Relocating the turbines is an unlikely possibility. Purchasing the residences is another difficult possibility. Planning the farm is the best possibility. Coordination with the NCO and community officials during the planning stages is critical. It is very important to determine the sound characteristics of the planned units based on actual data. These characteristics are the sound pressure levels (and spectrum) at various distances at various wind speeds downwind from the most likely wind direction. With that data an acoustician can determine contours based on propagation variations caused by temperature and wind gradients.

## **7.24 Propane Cannons**

Official response can be based on complaints. Curfew hours in Alternative 1 provide a clear method of enforcement while at other hours it becomes a subjective evaluation of noise impact by a NCO. Alternative 2 requires the NCO to count the frequency of blasts over at least an hour period, but cannon distances can be enforced more easily if a handheld distance measuring device is available. Alternative 3 is a prohibition on cannon use. In each case, it is prudent to require complainants to keep written records of the periods cannons are in use.



## 7.25 Fracking Operations

Official response can be based on complaints. Since fracking has three noise related stages, enforcement must be different for each. During the construction stage, enforcement should follow that noted in Provision 7.6. During operation, the site becomes a stationary noise source so the enforcement methods of Provisions 9.1 and 9.2 apply. The considerable truck traffic is subject to enforcement under Provisions 10.1 and 10.6 which requires monitoring by the NCO.

## 7.25 Unmanned Aircraft Systems (Drones)

Official response can be based on complaints. The curfew in Alternative 1 may straightforward to enforce. Alternative 2 is similar to that for a stationary noise source so the enforcement methods of Provisions 9.1 and 9.2 apply. In each case, it is prudent to require complainants to keep written records of the periods of noise impact. Definition of noise impact is considerably easier than identification of the aircraft or the person operating it. Federal rules for non-commercial drones require that the operator be in line-of-sight to the aircraft; it will not always be a line-of-sight from listener to operator. Enforcement is made easier if the aircraft are required to be clearly marked, so they are identifiable and the owner is required to register it.

# Article IX SOUND LEVELS BY RECEIVING LAND USE

## 9.1 Maximum Permissible Sound Pressure Levels

Normally, official response is based on complaints. The primary purpose of this provision is to protect residents from the excessive sound of their neighbors. It pertains to the sound from “stationary” sources, both ones that vary in level and those that create steady levels. “Stationary” means that a sound source may be able to move, but is constrained to a particular property or area (e.g., lawnmower). If other provisions (most of Article VII) can be applied to the source of interest, it is better to use them. They help potential violators to understand what is expected (fair warning) and to simplify enforcement since sound level measurements may not be needed.

### Quality of the Sound Level Meter

Meters are required for enforcement of this article. The quality (and cost) depends on which particular provision is applicable. There are a large number of meters available and they change continually. In every case, the meter should be guaranteed to be Type 1 or 2. The meter should **not** have a continuous digital level read out (too much fluctuation) if a manual reading is required. Unfortunately they are hard to find. The items below are tied to the alternatives in Provisions 9.1 in Chapter 6.

#### *Alternative 1*

This alternative needs only a simple meter. It should be set at SLOW response and at A-Weighting. An added benefit would be the ability to store the measurement.

#### *Alternative 2*

Unlike dosimeters, there are no meters that provide a reading of the amount of time above a specific level at environmental sound levels. A simple meter can be used but subjective judgment is needed to determine the time of excessive levels. The meter should be set at SLOW response and at A-Weighting. If a meter that can determine percentile levels is available then it simplifies the determination.

#### *Alternative 3*

This alternative needs a meter than can determine  $L_{eq}$ . The meter should be set at SLOW response and at A-Weighting.

#### *Alternative 4*

This alternative needs only a simple meter for both measurements. The meter should be set at SLOW response and at A-Weighting. An added benefit would be the ability to store the measurements.

#### *Alternative 5*

This alternative needs a meter than can determine percentile levels. It should be capable of storing the results and downloading them to a spreadsheet. The meter should be set at SLOW response and at A-Weighting.

#### *Alternative 6*

This alternative needs a meter than can measure octave band sound levels. It should be capable of storing the results and downloading them to a spreadsheet. The meter should be set at SLOW response and Flat-Weighting for band measurements.

#### *Alternative 7*

This alternative needs a meter than can measure octave band sound levels as well as A-weighted levels. The meter should be set at Flat for band measurements. It should be capable of storing the results and downloading them to a spreadsheet.

#### *Merged Alternative*

See the above alternatives, depending on which section is being applied.

### **Separating the Ambient from the Source**

The major issue for an NCO is to ensure that the measured levels can be attributed definitely to the alleged violator. Unfortunately, there are situations where a complaint might occur but a definitive determination of violation cannot be made because of interference from the ambient (the sound from everywhere other than the source of interest). If the interfering sounds are significant transients, such as car horns or over flights, the readings have to be abandoned. Generally, ambient levels are *reasonably* steady in level, have a broadband spectrum, and come from all directions (diffuse), so a complaint about the ambient itself is unlikely.

There are two cases for measuring the ambient:

***The source can be turned off.***

*Alternatives 1, 2, 4.* Read the meter with SLOW A-weighting for at least 10 minutes and weight the estimated level toward the higher readings.

*Alternative 3.* Have the meter collect data with SLOW A-weighting for at least 10 minutes in the  $L_{eq}$  mode. Take several 10 minute samples and choose the higher of the results.

*Alternative 5.* Have the meter collect percentile levels for at least 10 minutes. Despite the fact that a distribution of percentiles will result, use the  $L_{90}$  value as the ambient. Make sure the lowest levels are **not** coming from the source of interest.

*Alternative 6.* Have the meter collect data with SLOW A-weighting for at least 10 minutes in the  $L_{eq}$  mode, and if possible, collect the  $L_{eq}$  for each of the octave bands.

*Alternative 7.* Have the meter collect data with SLOW A-weighting for at least 10 minutes in the  $L_{eq}$  mode and one octave band levels. Use Table 9-3 to determine the maximum octave band levels using the next highest A-weighted level in the table. Each band must be within tolerance dB set in the provision.

*Merged Alternative.* Collect data relevant to the sub-provision in use.

### ***The source cannot be turned off***

With eyes closed, attempt to point at the source of sound. If it is easy to do, it is likely that the source is nearly 10 dB louder than the ambient so there is no interference problem.

If not, choose a location that has about the same environment as the desired measurement location but is considerably further from the source of interest so it has little effect. The major consideration is to have a sound environment similar to that at the correct measurement point. It is likely that the measurement there will be representative of the ambient at the correct location. Then collect the data as suggested when the source can be turned off. Collect geometry data (a picture of both locations) so the procedure can be justified later.

If the ambient levels are above the fixed level limit for either of the above cases, obtain feedback from a complainant on what times are the most annoying; it could provide input on when the ambient is lowest. Again, if the ambient result is above the provision limit, no enforcement is possible under Article IX and other provisions of the ordinance should be examined for possible application. Denver, CO notes that if the ambient sound is above the maximum permitted levels, the maximum permitted level of the source may not increase it. For an accuracy of 1 dB, the sound source must be at least 5 dB below the ambient. This might be an arguable item in a court case since few people can detect 1 dB increases. A more reasonable enforcement would be a 3 dB increase so the ambient and the source are both of the same level. The change is barely detectable. If the ambient level is above the level limits, Hartford, CT permits the source to be above the ambient by 5 dB, provided that the level is not in excess of 80 dB(A).

### **Enforcement Locations**

Table 9-1 of Chapter 6 divides impact locations into three broad categories; residential, commercial, and industrial. Some ordinances create finer subdivisions (e.g., single family homes vs. apartment buildings); this only creates more difficulty in enforcement and only marginally furthers the goal of the ordinance. The difficulty of zoning categories is that the actual use may not reflect the zoning. For example, an impacted residence may actually be in a commercial zone. This case can create a problem for an NCO. The health and welfare provisions may provide justification for treating that case as residential.

The location should be on the receiving side in the appropriate zone and measurements must be made at the property boundary *or beyond* (toward the impacted area). The theory of measurements just beyond the property boundary is based on the fact that the acoustical trash is first thrown there. Two problems may occur at the boundary. First, there may be a wall very near the property boundary shielding a ground level source. Higher levels will occur further into the property and the provisions allow for measurements there. In that case, it is prudent to move away from the wall to find the highest level, since people have the right to use their outdoor property. See Appendix C.7 for some suggestions. Second, a residence may have multiple floors, any of which may be impacted and the provisions allow measurements above ground level. A difficult choice for the NCO is the extension of the meaning of the provision to allow measurements *within* a residence (open or closed windows?). This situation occurs quite often. For example, the sound of rooftop air conditioners can propagate between high rise apartment buildings. If the offender is required to reduce the sound output of his equipment, it is prudent and fair to the offender to measure at other potentially impacted sites. This may prevent a succession of complaints about the source if only the original complaint is resolved (perhaps by a barrier).

## 9.2 Corrections for Character of Sound

Again, this provision is intended to apply to stationary sound sources and official response is by complaint. It is not always easy to enforce this provision.

The definition of a pure tone (3.34) permits both subjective and objective methods of identifying it. While the subjective aspect is more difficult to prove, an objective measurement is readily defensible, but takes more time and equipment. Measurement requires a meter with at least the capability to measure one octave band levels. Since the provision requires a continuous steady source, a short term measurement is all that is required. Comparison of the adjacent bands to the most pronounced band is all that is required. Harmonic sounds do not contribute to the bands adjacent to the major band (which is normally the fundamental), so adjacent bands should be considerably lower if a tone exists.

Impulsive sounds are not always easy to enforce. Although the definition of “short” is one second, the time is unlikely to be measured. In addition, the words “abrupt increase and decrease” are difficult to define precisely. Identification of the source can be used to help provide that definition. Gun shots and drop hammers are clearly accepted as impulse sources. Precise measurement requires a meter with a peak detector which may, or may not, be available on the existing meter. A meter set with SLOW (or FAST) response and MAX HOLD can be used for this purpose. The response time is so slow that the reading will never reach the actual peak and so will provide some unmeasured tolerance.

In many situations a “pure tone” can be determined by simply listening (subjective). There are several ways to avoid use of a meter. If the source is a whistle, or musical instrument, there is seldom dispute. Recording the sound for presentation to a court is also helpful.

## 9.3 Exemptions

Make sure the exemptions listed do not conflict with prohibitions elsewhere in the ordinance, particularly those that can be interpreted as limitations of free speech. Columbus, OH requires that an application be made to the Board of Health for a variance.

# Article X MOTOR VEHICLE SOUND LEVELS

## 10.1 Motor Vehicles on Public Rights-of-Way

Monitoring the sound of vehicles has both active and complaint based components. Each community has several roadways that are either heavily traveled or popular with loud vehicles. Similar to active speed monitoring, active sound monitoring tends to make citizens aware of the need to control vehicle noise and to discourage those with straight pipes. Complaint based response is difficult on these streets as it is difficult for citizens to identify particular vehicles, so active monitoring is needed. On more local streets, sound from loud vehicles, operated by neighbors, generates complaints that will result in identification and local monitoring.

Most other provisions of this document are *immission* controls, concern is for the listener. The provisions in this article are *emission* controls, limiting the output of sound without regard for a specific listener. The necessary difference is that a moving vehicle is capable of impacting a larger number of people. Communities have adopted two ways to monitor vehicle sound. The first is to comply with the latest Society of Automotive Engineers (SAE) standards, such as J986, J331, J366, and J184 (Appendix D). The purpose of these standards is to allow determination of the sound output of a vehicle in a *scientifically* defensible way. These tests are mainly intended to standardize the tests of manufacturer's products in order to "level the playing field" so to speak. The intention of a noise ordinance is the health and welfare of the community and scientific precision is **not** an objective. An analogy with speed monitoring is appropriate. The speed in race tracks can be determined to tenths of mph while speed monitoring on a highway may have a 5 mph leeway. The practical difference for an NCO is in the monitoring site and the equipment used. SAE standards demand a specific site and specific environmental conditions. Complying with these restrictions, would restrain most community vehicle sound monitoring to very few locations. The standards also require close-in and careful sound tests of motorcycles and off-road vehicles. Since the ultimate purpose of the ordinance is to protect the citizens, distance plays an important role, making an SAE test helpful but not definitive. The point of these comments is to recommend that SAE standards **not** be the basis for motor vehicle sound monitoring. Although they may be helpful, they consume much time and fiscal resources.

The avoidance of scientific precision makes many community sites available for on-road vehicle monitoring. The use of reflection and distance corrections (Appendices C.5 and C.8) are sufficient to provide an adequate margin of safety to offset uncertainties.

### Measurement Methods

The following comments apply to all types of motor vehicles, including road vehicles, off-road vehicles, snowmobiles, and watercraft. The most common can be called the "passby measurement" where a monitoring site is set up and measurements are made as vehicles pass by.

### Limit Tolerances

The sound of a motor vehicle increases with speed (Appendix B.3). The maximum is set for vehicles moving at, or above, the posted speed limit break. Vehicles going slower than the break should be quieter and require less tolerance since the sound limit at the break is for vehicles at the posted speed limit. For vehicles moving at speeds above the posted speed limit break, a limit tolerance is reasonable. Many communities restrict upper speeds on major roads to

45 mph. At that speed, a vehicle will make about 4 dB more sound than one at 35 mph. A review of Table B-2 in Appendix B shows that thought-out vehicle sound limits are 6 dB higher at the higher speeds suggesting that 50 mph is the actual norm, allowing for vehicles over the limit. If the actual speeds are 55 mph (either permitted or not), the level rise is more like 8 dB (Table B-5 in Appendix B), so a limit tolerance of 2 dB would be reasonable. Some state and local ordinances allow either a 2 or 4 dB tolerance for non-interstate trucks over 10,000 pounds GVWR, for posted speed limits greater than 35 mph. In most cases a 2 dB tolerance is sufficient to provide an adequate margin of safety to offset uncertainties. A further 2 dB tolerance can be added for vehicles moving up grades greater than 3%. The tolerance must be set by local policy.

### **Measurement Distance**

Much testing over many years has standardized on a measurement distance of 50 feet. At that distance, ground reflections tend to average out and the sound from all parts of the vehicle is better integrated. At greater distances, ambient sounds (Appendix C.3) can influence the accuracy of the measurement. In almost all vehicle passby measurements, the ambient is not a factor, but the sound from vehicle density can be. To avoid interference from other vehicles, there should be no vehicle in far lanes at same time, and the vehicles in the same lane should be at least 30 feet (about 2 car lengths) away from the vehicle being measured. If these conditions are met, the limit tolerance noted above would be adequate. On large roadways 50 feet is a practical distance, but inside a community it can be a serious impediment to enforcement. Since it is reasonable to set maximum levels at a specific standardized distance of 50 feet, a table of corrections can be used for other measurement distances (Appendix C.8).

Another factor is the influence of surrounding structures. For example, in an urban area, parked cars get in the way and building reflections can alter the measurement. The line of sight to the motor vehicle must be clear with obstructions at least 10 feet to either side of the direct line to the vehicle. This type of restriction suggests that measurements should **not** be made with a row of parked cars in the way. It is possible to correct for the presence of a tall building (worst case) directly behind the observer using the corrections in Appendix C.5. The reflection is considerably less at other angles and for more irregular structures.

## **10.2 Motorboats**

Normally, official response is based on complaints. The Alternative 1 is subjective enforcement and more difficult to defend. It should be noted that it does not define the location of the listener. They can be on shore or in another boat. There could be many successful objections to such enforcement. The Alternative 2 uses an objective measurement as the criterion for disturbance, but requires the boat to be operating, and some monitoring to establish the maximum level and the approximate distance at the time of measurement. Note that this alternative also can be applied on shore or in another boat. Alternative 3 implies that the body of water, whether public or private, is another property, so the provisions of Article IX are applicable. Although Article IX was intended primarily for stationary sources, motorboats being spatially constrained in a lake, waterway, or canal, can be treated as variable level stationary sources. In some states, authorities use patrol boats to monitor reckless behavior and speeding. They can be used as sound monitoring locations. Note that there is no separation between public and private property.

### 10.3 Recreational Snowmobiles on Public Property

Normally, official response is based on complaints. The provision has three parts. The first part is an objective *emission* control which requires setting up a monitoring location with all of its attendant complications. It is within the authority of the NCO to require passby tests on public property (similar to SAE J1162 or SAE J2567). The curfew part is straightforward to enforce. The third part is a subjective *immission* control and is the most likely part to be used. Snowmobile mufflers are subject to tampering, so Provision 10.6 is applicable. In most cases, really loud violators likely may have modified their mufflers, so use of 10.6 is probably the strongest enforcement tool.

### 10.4 Recreational Off-Road Vehicles on Public Property

Normally, official response is based on complaints. Alternative 1 has three parts. The first is an objective *emission* control which requires setting up a monitoring location with all its attendant complications. It is within the authority of the NCO to require passby tests on public property (similar to SAE J1175 or SAE J1492). The curfew part is straightforward to enforce. The third part is a subjective *immission* control and is the most likely part to be used. Off-road vehicle mufflers are subject to tampering, so section 10.6 is applicable. In most cases, really loud violators may have modified their mufflers, so use of 10.6 is probably the strongest enforcement tool. Alternative 2 is Alternative 1 applied also to private property. Alternative 3 has only a distance restriction as is common in some ordinances.

Chicago, IL requires that vehicle noise measurements be conducted in accordance with the latest Society of Automotive Engineers standards (Appendix D). Such precision is **not** warranted (see discussion under 10.1 of this chapter). Noise is only one factor for these vehicles; dust, destruction of vegetation, and disruption of wildlife are several that should be brought to the attention of a violator.

### 10.5 Motor Vehicle Sound Systems

Normally, official response is based on complaints. The provision has three parts. The first is an *objective emission* control. Enforcement is best while the vehicle is in motion so that the operator is not aware of why a measurement is being made. If it is stopped by the NCO, the level is likely to be lowered. If it is not possible to make the measurement at the required distance, make it at either  $\frac{1}{2}$  or  $\frac{1}{4}$  the distance (Appendix C.9) and apply the correction. The second part is a “plainly audible” provision and does not require a sound level meter (page 7-12). The third part applies to common carriers and no sound level meter is required.

If persons in St. Petersburg, FL can identify a license plate of a boom box operator, the city will send an official letter to the offender. A study in Savannah, GA indicated that warnings were particularly ineffective and citizens were encouraged to record information in a log and give the log to police so they can send out a warning letter to the registered owner of the vehicle. Use of the “plainly audible” criterion resulted in successful convictions.

The Colorado Springs, CO code states:

*“Upon a determination by the arresting officer that the sound amplification system will be removed at the scene, the arresting officer's designee shall conduct the removal of the sound amplification system. If the arresting officer determines,*



*in the officer's own discretion, that it is impractical to remove the sound amplification system at the scene of the violation, then the vehicle shall be impounded by the police for the limited purpose of the expedient removal of the sound amplification system. The sound amplification system shall remain impounded until ordered released or forfeited by the court.....”*

Below are listed some suggestions found in various locations on how to handle vehicle sound systems:

- **The provision is enforceable.**  
Sound level limits are referred to as *performance standard* laws. In the State v. Ewing, 914 P. 2d 549, Haw. 1996 it was found that a *plainly audible* standard is not unconstitutionally vague.
- **Enhance penalties in Residential or Noise Sensitive zones.**  
Because ambient sound levels are generally much lower in residential and noise sensitive zones, a loud car stereo has considerably more impact.
- **Enhance penalties for repeat offenders.**  
Higher fines and seizure of car stereo equipment provide a stronger response to repeat offenders.
- **Impound the offending vehicle.**  
Some jurisdictions, such as New York City and Chicago, authorize police to impound offending vehicles and to hold them as evidence until the citation has been adjudicated. The impoundment gives the offender extra incentive to appear in court and/or pay the fine and, at a minimum, removes the car from the streets for a brief time.
- **Hold the vehicle owner liable.**  
In most jurisdictions, the driver is liable for vehicle sound system violations. Because a NCO is seldom present when the violation occurs, the driver is not cited. If the license plate number is recorded by a listener, the *owner onus* principle (4.1.1 of Chapter 4) may be applied to the registered vehicle owner. The owner could then transfer the liability for the citation to the driver if they showed proof that someone else was operating the vehicle at the time of the offense. The advantage is that no traffic stops are required, similar to automatic speed monitoring systems.
- **Obtain nuisance abatement orders against vehicle owner.**  
Many jurisdictions have nuisance abatement laws and procedures that may be applicable to repeat offenders.

## 10.6 Adequate Mufflers or Sound Dissipative Devices

Official response can be complaint based or as a result of monitoring. At first it would seem redundant to have a Tampering (7.18) provision in addition to the present provision. Provision 7.18 applies to *all* engine sources, many of which are stationary, such as air compressors and home power equipment. This provision is more detailed and applies specifically to motor vehicles, a major source of community sound. Tampering applies to changes in mufflers while this provision applies also to any muffler that has degraded

performance. If the tampering provision (7.18) is included in the ordinance it is likely that parts (b) and (d) have been excluded.

Poor mufflers are a major source of vehicle sound, so this provision is a vital element of a noise ordinance. Poorly muffled trucks and cars are easily recognized by the character and level of the emitted sound. Typically, the vehicle is already in violation of Section 10.1, but not always. Poorly muffled vehicles can be operated in such a way as to pass the Section 10.1 requirements, especially when the driver is aware of being monitored. This provision acts to close that loophole.

See the “Soft Fuzz” discussion above for guidance on one method of enforcing this provision. The part (d) of the tampering provision (7.18) can be used as an effective preventive method if the authorities can be convinced to add it to the ordinance.

## **10.7 Motor Vehicle Horns and Signaling Devices**

Official response is complaint based. The first part is intended to reduce the excessive use of horns to signal someone or as an expression of frustration, or impatience. It is difficult to enforce and this part is generally used only in extreme cases. The second part is intended to limit the use of extremely loud air horns on automobiles, light or heavy trucks. The vehicle must be identified, stopped, and tested. It is not a common event. Vehicle theft alarms are covered in Provision 10.8. Emergency signaling devices are exempted but can be a significant source of community sound especially in well built up urban areas. The almost automatic action for an emergency vehicle driver is to start the siren, whether there is any need or not. The justification is for safety and likely insurance protection, but it is also a pseudo-macho thing. The sonic impact is enormous, particularly in residential areas. Training drivers to make judicious use of their sirens goes a long way to improving community relations. In warmer climates the open window of the vehicle results in the occupants being exposed to hearing loss and potential claims. It should be a policy to prevent use of the especially powerful new sirens since it has not been proven that any benefit accrues, except for the manufacturer. It should be policy to train drivers to use their siren only when needed. Continual activation reduces alertness by listeners while transient use elicits more immediate attention.

## **10.8 Motor Vehicle Theft Alarms**

Official response is complaint based. Most complaints are based on continual alarm events, probably caused by excessively sensitive settings or other cars passing close to the vehicle and rocking it. Complainants should be asked to determine the amount of time the alarm sounded. Identification of the vehicle and its owner is mandatory. Because the purpose of the alarm is property protection, it is recommended that the first enforcement be a warning followed by a citation for repeated events. If the ordinance prohibits audible theft alarms, the vehicle owner should be so notified.

## **10.9 Motor Vehicle Tire Squeal\Street Drag Racing**

Official response is complaint based. Most complaints are based on continual excessive acceleration by neighborhood vehicles. Identification of the vehicle and its owner is mandatory. Most events are created by juvenile or careless drivers who are unaware of the impact of their

actions. Often the vehicle has been modified to create more sound, so a muffler check is recommended. Enforcement by warning is recommended if the exhaust sound is not excessive, followed by a citation for repeated events.

## 10.10 Refuse Collection Vehicles

Official response is complaint based. Alternative 1 is an *objective emission* control that can be applied to all refuse collection vehicles at a central location as opposed to measurements during collection operations. Alternative 2 is Alternative 1 with an added curfew. Alternative 3 is a *subjective immission* control. This alternative is more difficult to enforce since collection is necessary and distances from listeners will vary greatly during collection. If Alternative 3 is in the ordinance, a recommendation to alter the provision to an objective standard, such as Alternatives 1 and 2, should be made.

Refuse collection is a necessary evil and modern technology uses machines that make sound unavoidably. There are two sounds: those of the vehicle itself, and those of the refuse containers. If the offense is due to high sound emission from the vehicle, measurements must be made. They are owned and operated by commercial organizations, so the first response should be a warning to company officials. There are occasions where a particular driver is at fault and that can be corrected by the company. At other times, the scheduling is such that the curfew is violated; that can be corrected by the company. Modern residential refuse receptacles are plastic, reducing the sound output substantially, so the recommended provisions include reference only to the sound of the vehicle. If metal containers are the problem, they should be replaced.

## 10.11 Standing Motor Vehicles

Official response is complaint based. Identification of the vehicle and the amount of time operated while standing can be determined readily. Most of the events occur while trucks are located in commercial zones, such as loading docks or motels, and send sound into residential zones. In winter, trucks in motels or truck stops will keep their engines running even at night, creating both time limit and curfew problems. Although the ordinance provision cites a distance, if a barrier is erected on the offending property, the intruding level may be sufficiently reduced that no noise disturbance occurs, regardless of the distance. If the vehicle is part of the business, then erecting the barrier by the business would be part of the solution. If the vehicle is not part of the business (at a motel or fueling station) the property owner will be reluctant to pay for the barrier. One weakness in the recommended provision is that certain diesel pickup trucks which do not meet the weight requirement can create a noise disturbance, particularly in residential areas. If these events occur, a modification to the ordinance should be recommended. Enforcement of standing vehicles in traffic jams is not recommended, but if the jam is to be excessively long they could be asked to turn off the motors to save fuel and reduce sound.

## 10.12 Motor Vehicle Racing Events

Official response is complaint based. These complaints may address noise in addition to other factors such as odors, dust, and excessive traffic. For enforcement of this provision it is important for the NCO to insure that the noise aspect is the main complaint.

If part (a) of the provision is included, tests of all racing vehicles would be required prior to any event if they had not been tested for prior events. It may be that official authorization for the event includes a provision for such testing. This would be a very time and manpower consuming task for an NCO, unless the permit states that the tests must be performed by the event operators. Part (b) requires the event operators have a sound level meter and monitor the sound levels. The recommended location would be at the positions of attendees nearest the vehicle path. The curfew hours in part (c), although in the ordinance, may be altered by a provision in the event permit. Part (d) allows the NCO to shutdown any informal racing events.

The conflict between an audience wanting noise and the event operators willing supply it, and the surrounding community that does not, creates difficulties for an NCO. The potential for hearing damage to track attendees and noise disturbance for residents makes it imperative to take action based solely on protecting the health and welfare of its citizens. There seems to be no evidence of enforcement to protect the hearing of voluntary attendees, only that to protect the surrounding neighborhood. In many cases, using the land use sound limits for enforcement might result in shutdown of an otherwise authorized event, so alternate approaches are recommended. The strongest enforcement tool is the requirement that racing activity must cease at a particular time.

Residents are more accepting if they believe that an attempt to quiet the events is being made. For events at permanent facilities, statements by the owners in the press that efforts are being made to quiet the facility should be encouraged. Drivers should be encouraged to wear hearing protection in their helmets. Many vehicles have home-made mufflers that add to the sound. The local economy is aided by requiring that the vehicles have effective commercial mufflers that reduce levels (Provision 10.6). One objection is that mufflers cause the engines to overheat. The community benefit can be large, however. Mufflers can reduce sound output by 20 dB and, if reduced, the impacted community area would be **1%** of the previous impacted area! Another benefit is to have the exhausts horizontal at ground level rather than vertical to take advantage of any sound barriers that exist. Owners doing sound checks using SAE test procedures to separate noisy vehicles is recommended.

### 10.13 Engine Braking Devices

Official response can be complaint based or can be in active monitoring on steep downgrade truck routes where braking device use is likely. The sound of an engine brake in operation is so distinctive that identification of the vehicle is not a problem. In areas where brake use is prohibited, no measurement need be made. In areas where it is not prohibited and when an adequate muffler is in operation, the muting is also clearly evident; the sound is barely above normal vehicle sounds. If the exhaust is not properly muffled, Provision 10.6 becomes applicable as well as this provision. If a sound level meter is on site, Article X can be used to establish a violation. If the vehicle is halted, a standing engine run up with the brake activated can be used to verify the muffler condition. Some cities use Alternative 2, probably based on the concept that vehicle speed should be sufficiently slow that engine brakes are not required.

### 10.14 Airboats/Hovercraft

Official response can be complaint based and enforcement has several parts. Part (a) is an *objective emission* control which can be enforced by monitoring or by a mandatory passby test.

Part (b) is a curfew. Part (c) is a *subjective immission* control which requires identification of the vehicle and its owner or operator. In constrained areas, Article IX may be used as a numerical criterion for establishing disturbance. It requires sound level meter use during the passing of the vehicle. Part (d) requires ear protection for both the operator and the passengers. Inspection powers are required for enforcing that part. State regulations should be checked.

### **10.15 Railroads**

If railroad noise is a problem, current federal and any state regulations need to be checked first. If trains horns are the problem, the number of crossings in the community should be determined and the city officials approached about creating a Quiet Zone. If the problem is local car use for loading and unloading operations, the community may have some leverage to use Article IX for an industrial zone, and may require the offending property to erect noise barriers.

## Appendix A

### Existing Land Use Sound Limits

This appendix lists **existing** land use maximum sound levels for a large number of states and communities. These are *immission* levels: the sound levels not to be exceeded at a listener's location which can be residential, commercial or industrial. The list is intended to provide the reader with examples of what is being done so they can better write or modify their ordinance.

Most jurisdictions mandate different intruding sound levels for different times of day (and sometimes on weekends). Although some acoustical metrics separate the entire day into day, evening and night segments, almost all communities use only day and night as shown in Section A.1. It simplifies enforcement and “evening” categories are considered unnecessary for most community noise problems. The maximum levels are shown separately for states and communities in Sections A.2 and A.3 respectively. A number of the jurisdictions have interesting variations on how those maximum levels are defined and enforced. Many are described separately in the sections below.

#### A.1 State and City Time Categories

The first decision for land use limits is to define the times of day and night. Note that a choice of these limits does not necessarily limit the use of other times for other sources of sound. For example it is possible to have a provision that restricts construction activities to different hours and even different days of the week. Such times have to be specifically included in the provision. Examples of time categories are given in Table A-1 for both states and communities. The table shows the widespread popularity of the 7am to 10 pm categories.

Community	Land Use Category	Day	Evening	Night
Hawaii, Illinois Connecticut, New Jersey, Washington Minnesota Albuquerque, NM Anchorage, AK, Columbus, OH Dallas, TX Portland, OR Denver, CO Green Bay, WI Lakewood, CO, Lincoln, NE Los Angeles, CA New Orleans, LA New York City Orlando, FL Richmond, CA, Sacramento, CA Salt Lake City, UT Milwaukee, WI Lincoln, NE	All	7 am to 10 pm		10 pm to 7 am
Boulder, CO	All	7 am to 11 pm		11 pm to 7 am
Colorado Colorado Springs, CO	All	7 am to 7 pm		7 pm to 7 am
San Diego, CA	Residential Commercial Industrial	7 am to 7 pm 7 am to 10 pm	7 pm to 10 pm 7 pm to 10 pm No time restrictions	10 pm to 7 am 10 pm to 7 am
Boulder County, CO Madison, WI	Residential Commercial Industrial	7 am to 7 pm	No time restrictions No time restrictions	7 pm to 7 am
New York	Residential Commercial Industrial	7 am to 10 pm	No time restrictions No time restrictions	10 pm to 7 am
San Francisco, CA	Residential Commercial Industrial	7 am to 10 pm 7 am to 10 pm	No time restrictions	10 pm to 7 am 10 pm to 7 am
Hawthorne, CA	All	No time restrictions		
Baltimore, MD Omaha, NE	All	7 am to 9 pm		9 pm to 7 am
Boston, MA	All	7 am to 6 pm		6 pm to 7 am
Seattle, WA	All	7 am to 10 pm Weekdays 9 am to 10 pm Weekends, holidays		10 pm to 7 am Weekdays 10 pm to 9 am Weekends, holidays
Sacramento, CA Chicago, IL	Residential	7 am to 10 pm		10 pm to 7 am
Omaha, NE	All	7 am to 9 pm		9 pm to 7 am

***Table A-1 Commonly used time-of-day categories***



## A.2 State Statutes and Regulations

Although noise impact in various land use categories is a purely a local affair, many states consider the need for statewide uniformity to be important. Some states prohibit communities from deviating from the state statute (New Jersey), while others require local ordinances to be at least as strict. Several states allow the local jurisdictions to set their own standards. In contemplating a local ordinance, it is necessary to review state law. Examples of statutes are given in Table A-2.

State	Receiving Land Use Category					
	Residential		Commercial		Industrial	
	Day	Night	Day	Night	Day	Night
Colorado <sup>1</sup>	55	50	60	55	70-80	65-75
Connecticut <sup>2</sup>	55-61	45-51	55-66	55-66	62-70	62-70
Hawaii <sup>3</sup>	55	45	60	50	70	70
Illinois <sup>4</sup>						
Maryland	65	55	67	62	77	75
Michigan <sup>5</sup>						
Minnesota <sup>6</sup>	60	50	65	65	75	75
New Jersey <sup>7</sup>	65	50	65	65	-	-
Washington <sup>8</sup>						

**Table A-2. State land use maximum sound levels**

1. Light/Heavy Industrial category (Can be exceeded by 10 dB for 10 minutes every hour). It does not apply to snow making machines and to cultural events. Local communities are permitted to regulate cultural events, however.
2. See A.2.1 Connecticut.
3. 2 minutes in 20 must be 3 dB over ambient for violation.
4. See A.2.2 Illinois.
5. See A.2.3 Michigan.
6. See A.2.4 Minnesota.
7. See A.2.5 New Jersey.
8. See A.2.6 Washington.

### A.2.1 Connecticut

Connecticut subdivides the categories into both source and receiver categories as shown in Tables A-3 below. The levels shown are dB(A). The standards are a compromise between noise reduction of the source and the health and welfare of citizens.

They allow an exceedance above the maximum of 3 dB if the exceedance occurs for 15 minutes or less. The allowance is 6 dB if 7 ½ minutes or less and 8 dB if 3 minutes or less.

Source	Receptor			
	Industrial	Commercial	Residential(Day)	Residential(Night)
Residential	62	55	55	45
Commercial	62	62	55	45
Industrial	70	66	61	51

**Table A-3 Connecticut land use maximum sound levels**

## A.2.2 Illinois

Illinois has similar compromise standards to Connecticut as shown in Table A-4. However, the numbers shown are the A-weighted values of an **octave band spectrum**. They are shown for use in comparison with other ordinances. The difference is that **each** of the octave band sound levels **must** be met. See Illinois Title 35H, Chapter I, Part 901.102, for details. See Alternative 7 of Provision 10.1 and Table 9-3. Octave band measurements require skill on the part of the person measuring, more time to get a good sample, and a meter that can divide the sound spectrum into its parts. See information on filters on page 7-3.

Source  Land Use	Receiving Land Use			
	Residential		Commercial	
	Day	Night	Day	Night
Residential	55	44	55	55
Commercial	55	44	62	62
Industrial	61	51	66	66

**Table A-4 Illinois land use maximum sound levels**

Illinois also has maximum sound level limits for “highly impulsive sound” but measured with the more common fast A-weighted weighting rather than the peak detection. Table A-5 shows those limits. They also regulate the sound level from impact forging operations.

Classification of Land on which Property-Line Noise-Source: is Located	Allowable A-weighted Sound Levels in Decibels of Highly-Impulsive Sound Emitted to Receiving Class A or B Land		
	Class B Land	Class A Land Daytime	Class A Land Nighttime
Class A Land	47	47	37
Class B Land	54	47	37
Class C Land	58	53	43

**Table A-5 Illinois impulsive and impact maximum sound levels**

### A.2.3 Michigan

Michigan has a policy based on Noise Abatement Criteria (NAC) to achieve acceptable sound levels. The criteria are shown in Table A-6 below (see C.11.4 in Appendix C). It is based on both hourly energy levels (Definition 3.14).and tenth percentile levels (Definition 3.46) and has been developed by the Federal Highway Administration. It is used primarily to define the need for highway noise barriers.

Noise Abatement Criteria (NAC) <sup>1</sup> Hourly A-Weighted Sound Level - decibels (dBA)*			
Activity Category	Leq(h)	L10(h)	Description of Activity Category
A	57 (Exterior)	60 (Exterior)	Lands of which serenity and quiet are of extraordinary significance, serve an important public need, and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (Exterior)	70(Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (Exterior)	75 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	--	--	Undeveloped lands.
E	52 (Interior)	55 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.
* Either L10 (h) or Leq(h), but not both, may be used on a project.			

**Table A-6 Michigan land use Noise Abatement Criteria**

### A.2.4 Minnesota

Minnesota uses percentile levels to set land use limits as shown in Table A-7 below. The first classification applies to residential areas needing quiet and some lodging facilities. The second classification applies to commercial facilities, bus, railroad, marine, and airport terminals. The third classification applies to manufacturing facilities. The tenth percentile level is roughly equivalent to the maximum levels set in other ordinances. This method needs time to measure at a fixed location, and requires a meter that can collect percentile data. See C.2.6 in Appendix C for more details.

Noise Area Classification	Daytime		Nighttime	
	L <sub>50</sub>	L <sub>10</sub>	L <sub>50</sub>	L <sub>10</sub>
1	60	65	50	55
2	65	70	65	70
3	75	80	75	80

*Table A-7 Minnesota land use maximum sound levels*

### A.2.5 New Jersey

All communities in New Jersey must have ordinances that meet or exceed the state model code. See the New Jersey Noise Control Act of 2010. The code sets a variety of levels. For residential outdoor measurements, the maximum level is set at 65 dB(A) during the day and 50 dB(A) at night. For commercial zones, 65 dB(A) applies at all times. For residential *indoor* measurements, the maximum level is set at 55 dB(A) during the day and 40 dB(A) at night. Indoor levels for commercial facilities or non-residential multi-use facilities is 55 dB(A) at all times. These requirements are supplemented with octave band maximum sound levels that apply to sources that are “constant in level”. The spectra are shown in the Table A-8. The A-weighted levels are shown only for comparison purposes. They also have an ambient-plus requirement that applies to “sound production devices”. During night hours the ambient may be raised by 3 dB(C) and at other times by 6 dB(C).

Octave Band Frequency	Receiving Land Use					
	Residential				Commercial	
	Outdoors		Indoors		Outdoors	Indoors
	Day	Night	Day	Night	24 hours	24 Hours
31.5	96	86	86	76	96	86
63	82	71	72	61	82	72
125	74	61	64	51	74	64
250	67	53	57	43	67	57
500	63	48	53	38	63	53
1000	60	45	50	35	60	50
2000	57	42	47	32	57	47
4000	55	40	45	30	55	45
8000	53	38	43	28	53	43
A-Weighting	67	54	57	44	67	67

*Table A-8 New Jersey land use maximum octave band sound levels*

### A.2.6 Washington

Washington state also uses a matrix approach on land use maximum levels as shown in Table A-9. They allow exceedances as follows:

Up to 15 minutes in one hour: 5 dB

Up to 5 minutes in one hour: 10 dB

Up to 1.5 minutes in one hour: 15 dB

Noise Source	Receiving Property Maximum levels, dB(A)			
	Class A Daytime	Class A Nighttime	Class B All hours	Class C All hours
Class A	55	45	57	60
Class B	57	47	60	65
Class C	60	50	65	70

**Table A-9 Washington land use maximum sound levels**

## A.3 Cities

Table A-10 shows the land use regulations for several cities. The maximum levels shown are calculated in several ways. In some, it is the maximum instantaneous level, in others it is the hourly average,  $L_{eq}(h)$  and in others it is a percentile level such as  $L_{10}$ . Many communities state that when crossing from one zone to another, the lower maximum level applies.

Community	Receiving Land Use Category					
	Residential		Commercial		Industrial	
	Day	Night	Day	Night	Day	Night
Albuquerque, NM	55	50	65	60	75	70
Boulder, CO	55	50	65	60	80	75
Boulder County CO	55	50	-	-	-	-
Chicago, IL <sup>1</sup>	55-61		62-65			
Colorado Springs, CO	55	50	60	55	70-80	65-75
Columbus, OH	65	60	75	70	80	80
Dallas, TX <sup>2</sup>	56	49	63	56	70	63
Denver, CO	55	50	65	60	80	75
Fort Collins, CO	55	50	60	55	80	75
Green Bay, WI <sup>3</sup>	57	52	63	58	72	67
Hartford, CT <sup>4</sup>						
Houston, TX	65	58	68	68	68	68
Kenosha, WI	60	50	70	70	75	75
Lincoln, NE <sup>5</sup>						
Los Angeles, CA <sup>6</sup>						
Madison, WI	75	70	80	80	80	80
Miami, FL <sup>7</sup>	60	55	65	65	75	70
Milwaukee, WI <sup>8</sup>	55	45	60	50	65	55
New York City <sup>9</sup>						
Omaha, NE	60-65	55-60	70-75	65-70	80-95	75-80
Orlando, FL <sup>10</sup>						
Portland, OR <sup>11</sup>						
Richmond, CA <sup>12</sup>						
Sacramento, CA <sup>13</sup>	55	50				
Salt Lake City, UT <sup>14</sup>						
San Diego, CA <sup>15</sup>						
Seattle, WA <sup>16</sup>						

**Table A-10. Examples of existing city land use maximum levels.**

## Superscript index

1. See A.3.1 Chicago, Illinois.
2. See A.3.2 Dallas, Texas.
3. See A.3.3 Green Bay, Wisconsin.
4. See A.3.4.Hartford, CT.
5. See A.3.5 Lincoln, Nebraska.
6. See A.3.6 Los Angeles, California.
7. See A.3.7 Miami, Florida.
8. See A.3.8 Milwaukee, Wisconsin.
- 9 See A.3.9 New York City, New York.
10. See A.3.10 Orlando, Florida.
11. See A.3.11 Portland, Oregon.
12. See A.3.12 Richmond, CA.
13. See A.3.13 Sacramento California.
14. See A.3.14 Salt Lake City, Utah.
16. See A.3.15 San Diego, California.
17. See A3.16 Seattle, Washington.

### A.3.1 Chicago, Illinois

Chicago regulates the sound from industrial areas to residential and commercial areas as shown in Table A-11. Although the limiting levels are given in dB(A), each receiver category has an **octave band spectrum** associated with it. Each frequency band from 31.5 to 8000 Hz must also meet the limits. It is very restrictive and complex to measure. Airports, stadiums, mass transit vehicles are exempt.

Industrial Category	Receiver Category	
	Residential dB(A)	Commercial dB(A)
M1	55	62
M2	58	64
M3	61	65

*Table A-11 Chicago, IL land use maximum sound levels*

### A.3.2 Dallas, Texas

For impulsive sound, the limits are reduced by 7 dB. For periodic sounds that fit the On/Off cycles of Table A-12, the limit is increased by 10 dB.

**Example:** If a source is on 7 minutes in a one hour period it is in violation, but if it is on only 7 minutes in a two hour period it is not in violation. This might be difficult to enforce.

Total Time, Hours	On Time, Minutes	On Time, Percentage
½	½	2
1	5	8
2	10	8
4	20	8

*Table A-12 Dallas, TX allowance for intermittent sounds*

### A.3.3 Green Bay Wisconsin

This city has a more complex requirement for noise impact. For each of the A-weighted values listed in Table A-13, there is an **octave band maximum spectrum** associated with it for both daytime and nighttime hours. In addition, they have specific maxima for sound transfer from one zone to another as shown in the table. Again the sound spectrum must also meet the maximum in each octave band. See Chapter 27.201.2a. This type of ordinance may be necessary for certain situations, but requires training, equipment and would be time consuming to enforce.

Source Category	Receiving Category			
	Residential		Commercial	
	Day	Night	Day	Night
Commercial	61	55		
Industrial	64	60	66	61

*Table A-13 Green Bay, WI land use maximum sound levels*

### A.3.4 Hartford, Connecticut

Hartford uses what might be called a matrix approach as does several states. It is a compromise between noise control of the source and the health and welfare of the citizens. .

Source Category	Receiving Category			
	Residential (Day)	Residential (Night)	Commercial	Industrial
Residential	55	45	55	62
Commercial	55	45	62	62
Industrial	61	51	66	70

*Table A-14 Hartford, CT land use maximum A-weighted sound levels*

### A.3.5 Lincoln, Nebraska

Lincoln has a number of less common, but useful, provisions in their noise ordinance. These are listed below.

The city provides separate maximum sound limits for noise sensitive and agricultural residential zones as shown in Table A-15. In most cases, they use one minute  $L_{eq}$  as the level measurement.

Time of Day	Maximum Level, dB(A)
7:00 a.m. to 10:00 p.m.	60
10:00 p.m. to 7:00 a.m.	50

*Table A-15 Lincoln, NE limits for noise sensitive zones*

Lincoln also has maximum sound level limits for impulsive sounds as shown in Table A-16 below. The requirement allows use of more common sound level meters that do not have a peak detector. It does imply that someone must be available for one hour or that the meter must be able to record or hold a sequence of fast response maxima.



Receiving Land Use Category	Time-of-Day	Number of Peaks per Hour	Maximum Peak Limit dB(A)*
Residential Noise Sensitive Agricultural residential	7:00 a.m. to 10:00 pm 10:00 p.m. to 7:00 am**	1	85
		2	79
		4	73
		8	67
		16+	61
Commercial	At all times	1	90
		2	84
		4	78
		8	72
		16+	66
Industrial	At all times	1	95
		2	89
Agricultural	6:00 a.m. to 10:00 pm 10:00 p.m. to 6:00 am**	4	83
		8	77
		16+	71

**Table A-16 Lincoln, NE limits for impulsive sounds.**

- \* Fast-hold meter function only.
- \*\* Reduce limits listed by 10 dB(A) for this period.
- \*\*\* Reduce limits listed by 20 dB(A) for this period.

Lincoln has set maximum levels close to the exhaust when the vehicle is stationary as shown in Table A-17. Measurements are made at 20 inches (0.5 meters) and at 45° angle from exhaust outlet with engine rpm at 3,000 for automobiles, vans, and light trucks; and at one-half indicated engine red line for motorcycles. Slow meter response is used. For dual exhausts, the higher measurement is used. If the exhaust is beneath the vehicle, measurements are taken 8 inches (0.2 meters) from the side of the vehicle.

Vehicle Type	Maximum Sound Level, dB(A)
Automobiles, vans, light trucks(GVWR< 10,000 lb)	
Front Engine	95 (93+2)
Rear and Mid Engine	99 (97+2)
Motorcycles	102 (100+2)
Heavy trucks (GVWR>10,000 lb)*	90 (88+2)

**Table A-17 Lincoln, NE close in limits for vehicle exhaust sound.**

\* Measurements are made at 50 feet (15 meters) with the transmission in neutral and engine revved from idle to wide-open throttle. Fast meter response is used.

Lincoln also provides a table of corrections for measurements made at distances other than fifty feet. It is the same as Table C.6 in Appendix C.

Lincoln also regulates the sound emitted by locomotives both under stationary and moving conditions. Table A-18 shows the maximum levels for stationary locomotives while Table A-19 shows the levels for moving locomotives. The measurement distance is 100 feet. These limits are consistent with those promulgated by the federal government under 40 CFR 201 and 40 CFR 202. The purpose of them is to permit local noise control officers to enforce those limits.

Manufacture Date	Maximum Sound Level dB(A)	
	Throttle at idle	Other throttle settings
On or before December 31, 1979	73	93
After December 31, 1979	70	87

***Table A-18 Lincoln, NE limits for sound from stationary locomotives.***

Manufacture Date	Maximum Sound Level dB(A)
On or before December 31, 1979	96
After December 31, 1979	90

***Table A-19 Lincoln, NE limits for sound from moving locomotives.***

A particularly unusual provision is that pertaining to sound levels that are considered an immediate threat to the health and welfare of its citizens. Continuous levels in this category are shown in Table A-20.

Maximum Continuous Sound Level, dB(A)	Duration
90	24 hours
93	12 hours
96	6 hours
99	3 hours
102	1.5 hours
105	45 minutes
108	22 minutes

***Table A-20 Lincoln, NE limits for continuous sound considered immediate threats.***

Impulsive levels in this category are shown in Table A-21.

Maximum Impulsive Sound Level, dB(A)	Number of repetitions
145	1
135	10
125	100

***Table A-21 Lincoln, NE limits for impulse sound considered immediate threats.***

Both of these provisions can be used beneficially in controlling the sound from and within places of public entertainment.

### A.3.6 Los Angeles, California

This city approaches land use regulation in yet another way. It defines “presumed” ambient levels as opposed to measured levels. It is a relative level provision rather than a fixed maximum level. Presumed ambient levels are shown in Table A-22. If the actual ambient is lower the table values are to be used as the reference. If the actual ambient is higher than the table values and the sound is *clearly audible*, **octave band** measurement may be used. The A-weighted level is measured and Table A-23 is entered to determine the maximum permitted octave band levels. If *any* band exceeds the table values, the source is in violation. Apparently, the purpose is to find a way around the ambient interference problem by examining the octave band spectrum. Even if the actual ambient is higher than the limits in Table A-22, if the spectrum fits the table, it is a spectrum that is generally acceptable to citizens and no violation occurs. This procedure requires the use of a more capable sound level meter and can be time consuming.

Use Category	Day dB(A)	Night dB(A)
Residential	50	40
Commercial	60	55
Public	60	55
Light Industrial	60	55
Industrial	65	65

**Table A-22 Los Angeles, CA  
presumed ambient sound levels**

dB(A)	Octave Band Center Frequency, Hz								
	31.5	63	125	250	500	1000	2000	4000	8000
35	58	50	42	35	32	29	26	23	20
40	61	54	46	40	37	34	31	28	25
45	64	58	51	45	42	39	36	33	30
50	67	61	55	50	47	44	41	38	35
55	70	64	60	55	52	49	46	43	40
60	73	68	64	60	57	54	51	48	45
65	76	72	68	65	62	59	56	53	50
70	79	76	73	70	67	64	61	58	55
75	84	81	78	75	72	69	66	63	60

**Table A-23 Los Angeles, CA land use maximum octave band sound levels**

### A.3.7 Miami, Florida

Miami uses a secondary limit in addition to fixed level limits. In residential and commercial zones, during the day, it allows the level to be 10 dB over the ambient and 5 dB over the ambient at night. In industrial zones, it allows 10 dB over the ambient during the day and 15 dB over the ambient at night. If the ambient is below the base level, the fixed levels of Table A-10 apply, otherwise the criteria above apply.

### A.3.8 Milwaukee, Wisconsin

This community has more divisions of the various land uses than those shown in Table A-10; they are shown in Table A-24. The evaluation of sound levels uses the ISO Noise Rating (NR) method. Measurements are made in one **octave bands** and fitted to the NR contours (see Appendix C.10). The octave band that penetrates the highest NR contour is the rating to be used in comparison with that in the table. If spectrum measurements cannot be made, A-weighted levels are measured instead. The NR rating is the measured A-weighted level value minus 8 dB.

District	Noise Rating Day	Noise Rating Night
Residential	55	45
Neighborhood Shopping	55	45
Other Commercial	60	50
Downtown	60	60
Industrial	65	55
Parks	55	45
Institutional	55	45
Planned Development (IH or IM)	65	55
Other Planned Development	55	45

*Table A-24 Milwaukee, WI land use Noise Rating maximum values*

### A.3.9 New York City, New York

New York divides the city into noise quality zones. Residential areas are subdivided into low and high density zones, while commercial and industrial zones are lumped together. They use the very practical Leq metric (See Appendix C. 2.5). The maximum levels are given in Table A-25.

Ambient noise quality zone	Day-time standards (7am - 10pm)	Night-time standards (10pm - 7am)
Noise quality zone N-1 (Low density residential RL; land-use zones R-1 to R-3)	Leq=60 dB(A) measured for any one hour	Leq=50 dB(A) measured for any one hour
Noise quality zone N-2 (High density residential RH; land-use zones R-4 to R-10)	Leq=65 dB(A) measured for any one hour	Leq=55 dB(A) measured for any one hour
Noise quality zone N-3 (All Commercial and manufacturing land-use zones)	Leq=70 dB(A) measured for any one hour	Leq=70 dB(A) measured for any one hour

*Table A-25 New York City land use maximum sound levels*

### A.3.10 Orlando, Florida

This city permits maximum levels to be measured with both A-weighting and C-weighting as shown in Table A-26. The ordinance does not state whether both, or either, must be exceeded to be in violation. They require that the maximum levels not be exceeded more than 5 minutes in any hour. They make no distinction between impact sounds and other sounds. The ordinance defines Class B as heavy manufacturing use as distinct from other uses. It is not clear how the listed levels are applied. The downtown entertainment area is also defined and that area has different time limits from the other areas. Weekdays are defined as from 2 AM Sunday to 11:59 PM on Friday. Weekends are from 12 AM Friday to 1:59 AM Sunday. They apply to Class B areas.

Property Noise	Generating	Class A Standard 7 AM—10 PM	Class A Standard 10 PM—7 AM	Class B Standard
Residential		60 dBA/65 dBC	55 dBA/60 dBC	65 dBA/70 dBC
Multi-Use		65 dBA/70dBC	55 dBA/60 dBC	65 dBA/70 dBC
Commercial		70 dBA/75 dBC	65 dBA/70 dBC	75 dBA/80 dBC
Industrial		75 dBA/80 dBC	75 dBA/70 dBC	85 dBA/90 dBC
Downtown Entertainment Ares		7 AM—11:59 PM 75dBA/80dBC	12 AM—7AM 70dBA/75dBC	Weekdays
		7 AM—1:59 AM 75 Dba/80 dBC	2 AM—7 AM 70 dBA/75 dBC	Weekends

*Table A-26 Orlando, FL maximum land use sound levels*

### A.3.11 Portland, Oregon

Portland uses the matrix array to define land use maximum levels. Day maximum sound levels in dB(A) are shown in Table A-27. Night maximum sound levels are 5 dB lower. Pure tone maximum sound levels are 5 dB lower in both day and night. Octave band sound level measurements can be used also to define a violation (Table A-28).

Source Category	Receiving Category			
	Residential	Public	Commercial	Industrial
Residential	55	55	60	65
Public	55	55	60	65
Commercial	60	60	70	70
Industrial	65	65	70	75

*Table A-27 Portland, OR land use maximum sound levels*

#### *Maximum Octave Band Sound Levels*

This type of measurement requires more complicated equipment and a trained person. The spectra in Table A-28 below slope downward with increasing frequency. At low A-weighted limits, there is more allowance for low frequency sound.

Limit dB(A)	Octave Band Center Frequency, Hz								
	31.5	63	125	250	500	1000	2000	4000	8000
45	64	58	51	46	42	39	36	33	30
50	65	62	56	50	46	43	40	37	34
55	68	65	61	55	52	49	46	43	40
60	72	68	64	60	56	54	51	48	45
65	76	72	68	64	61	59	56	53	50
70	79	76	72	69	66	64	61	58	55
75	82	79	76	73	71	69	66	63	60

**Table A-28. Portland, OR land use maximum octave band sound levels**

### A.3.12 Richmond, California

Richmond has a more complex method of setting maximum levels as shown in Table A-29.

Zoning District:	Maximum Noise Level in dBA (levels not to be exceeded more than 30 minutes in any hour)		Maximum Noise Level in dBA (level not to be exceeded more than 5 minutes in any hour)
	Measured at Property Line or District Boundary	Measured at Any Boundary of a Residential Zone	Between 10PM and 7AM***, Measured at Any Boundary of a Residential Zone
Single-Family Residential	60		
Multifamily Residential	65		
Commercial	70	60	50 or ambient noise level
Lt. Industrial and Office Flex*	70	60	50 or ambient noise level
Heavy and Marine Industrial	75	65	50 or ambient noise level
Public Facilities and Community Use	65	60	50 or ambient noise level
Open Space and Recreational Districts	65	60	50 or ambient noise level

**Table A-29. Richmond, CA land use maximum sound levels**

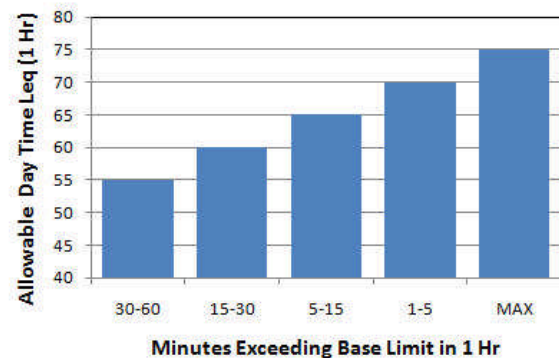
\* For M-1 and M-2 the measurement will be at property lines.

\*\* For M-3 and M-4 the measurement will be at boundary of the district.

\*\*\* Restricted hours may be modified through condition of an approved conditional use permit.

### A.3.13 Sacramento, CA

The Sacramento ordinance does not make the maximum levels for residential areas fixed, but takes into account the variability of the actual levels. This is done with a one hour measurement from which the amount of time the level exceeds that of the base level [55 dB(A) during the day in residential zones]. The allowances are shown graphically in Figure A-13. For example, if the level exceeds 55 dB(A) for 20 minutes, the allowed limit is 60 dB(A). Whether they are in violation of this new limit is determined by the  $L_{eq}$  measurement for that hour. The advantage of this method is that it takes into account the reality of the sound variations. One disadvantage is that it requires the time and equipment for a one hour measurement on a high quality meter. If in violation, the other disadvantage is how to assign the percentage of the level to an alleged violator as opposed to the ambient.



**Figure A-13 Sacramento, CA allowable exceedance**

Sacramento allows the land use sound levels to exceed the maximum level in any hour, in residential and agricultural zones, as shown in Table A-28 below. In Noise Sensitive zones, the *never to exceed* level is reduced to +10 dB.

Time Maximum is Exceeded	Permitted Exceedance, dB	Day Maximum, dB(A)	Night Maximum, dB(A)
30 minutes	0	55	50
15 minutes	+5	60	55
5 minutes	+10	65	60
1 minute	+15	70	65
Never to exceed	+20	75	70
If Impulsive levels	-5	50	45

**Table A-30 Sacramento, CA permitted maximum exceedance**

### A.3.14 Salt Lake City, Utah

Salt Lake uses the matrix approach to land use as shown in Table A-31. In addition, they have special conditions applicable to the ambient: the level may not be more than 10 dB above the ambient from 7 am to 10 pm, and 5 dB above the

Source Category	Receiving Category					
	Residential		Commercial		Industrial	
	Day	Night	Day	Night	Day	Night
Residential	55	50	55	50	55	50
Commercial	55	50	60	55	60	55
Industrial	55	50	60	55	80	75

**Table A-31 Salt Lake City, UT land use maximum sound levels**



ambient from 10 pm to 7 am. Pure tone and impulse corrections lower the limit by 5 dB. In addition, the  $L_{10}$  must not be more than 15 dB over the base levels when measured for 10 or more minutes.

### A.3.15 San Diego, CA

Other community provisions on land use maximum sound levels are *immission* controls, i.e. they regulate the sound entering an impacted property. It is aimed at protection of the listener. San Diego has reversed the concept to *emission* controls, i.e. they regulate the sound emanating from the source property. It has advantages; it applies to *all* surrounding listeners and can be used without a complaint being filed. The maximum sound levels at any point of the *emitting* property line are given in Table A-32.

Land Use	Time Of Day	$L_{eq}$ (1 hr)
Single Family Residential	7am to 7 pm	50
	7pm to 10 pm	45
	10 pm to 7 am	40
Multi-Family Residential	7am to 7 pm	55
	7pm to 10 pm	50
	10 pm to 7 am	45
All other Residential	7am to 7 pm	60
	7pm to 10 pm	55
	10 pm to 7 am	50
Commercial	7am to 7 pm	65
	7pm to 10 pm	60
	10 pm to 7 am	60
Industrial or Agricultural	Any Time	75

**Table A-32. San Diego, CA land use maximum sound levels**

### A.3.16 Seattle, WA

Seattle uses the same land use limit type as Portland, OR. Table A-33 shows the limits during day hours, and are reduced by 10 dB for night hours. Unlike other ordinances, the A-weighted levels noted in Table A-33 are either the  $L_{eq}$  measured over a one minute period for a steady source or the  $L_{eq}$  measured over one hour for a variable source. For each, the  $L_{max}$  must not be more than 15 dB over the  $L_{eq}$ . This method requires a more capable meter and more observer time. For pure tones and impulsive sounds, the limits are 5 dB less. Electrical power transformers are exempt.

Source Category	Receiver Category		
	Residential	Commercial	Industrial
Residential	55 dB(A)	57	60
Commercial	57	60	65
Industrial	60	65	70

***Table A-33 Seattle, WA land use maximum sound levels***

Seattle allows the land use sound levels to exceed the maximum level in any hour, in residential and agricultural zones, as shown in Table A-28 below. In Noise Sensitive zones, the never to exceed level is reduced to +10 dB.

Time Maximum is Exceeded	Permitted Exceedance, dB	Day Maximum, dB(A)	Night Maximum, dB(A)
30 minutes	0	55	50
15 minutes	+5	60	55
5 minutes	+10	65	60
1 minute	+15	70	65
Never to exceed	+20	75	70
If Impulsive levels	-5	50	45

***Table A-34 Seattle, WA land use exceedance criteria***

## Appendix B

### Existing Motor Vehicle Sound Limits

This appendix pertains to the sound made by land motor vehicles than can operate on public roadways. Other types of motor vehicles, such as snowmobiles and off-road vehicles are addressed directly in Chapter 6. The limits expressed here are *emission* limits, regulating the sound emitted by the vehicle, rather than the sound received by a citizen. A critical factor in determining whether a vehicle is in violation is the distance at which the measurement has been made. There are two ways to measure the emitted sound; by a test while the vehicle is stationary, and a test while the vehicle is moving. Stationary tests require the active participation of the vehicle operator, while moving tests (monitoring) can be accomplished without participation. The federal government, states and communities have regulations that limit the sound emitted by vehicles, and the Society of Automotive Engineers has a number of standards for making vehicle sound measurement. See Appendix D for a list. The most used measurement method is for vehicles moving on a public roadway, and since there are too many to list in Chapter 6, this appendix has been added to show existing regulations.

### B.1 Federal and State Laws

Community	Less than 35 mph					More than 35 mph				
	Trucks			Cars	Motor cycles	Trucks			Cars	Motor cycles
	6K	8K	10K			6K	8K	10K		
Federal			80		80			80		80
Arizona					76					83
California	80	80	80	76	80	80	80	80	82	80
Colorado	86	86	86	82	82	90	90	90	86	86
Connecticut	84			76	80	88			82 <sup>3</sup>	84
Florida			86	72	78			90	79	82
Illinois	74	74	86	74 <sup>2</sup>	80 <sup>2</sup>	82	82	90	82	86
Indiana	88			76	82	90			82	86
Michigan		86	86	76	82		90	90	82	86
Minnesota	75	75	80	75	80	75	75	90	75	83
Montana					70					70
Nebraska			86					90		
New Hampshire					80					80
Nevada	86	86	86	76	82	90	90	90	82	86
Ohio				70	82				79	86
Oregon			84	70	74			90	78	82
Pennsylvania	90			82	90	92			86	92
Rhode Island				86					90	
Washington <sup>1</sup>				72	78				78	82
Canada					92					92

**Table B-1 Motor vehicle sound limits by state**

1. Speed limits are 45 mph    2. Add 2 dB for 3% or greater grade    3. Add 2 dB for snow tires

The federal government (EPA) has identified vehicles that are worthy of noise control and have set limits. (See Section 4.2.1 for a list). Since they do no roadway monitoring, they require that new products for sale be certified to meet the requirements. Some states and communities have added similar provisions to permit the NCO to enforce the federal law. Some states limit any local ordinance to be at least as strict as the state statute. Note that not all states have vehicle sound limit laws Table B-1 shows existing federal and state limits when measured at a distance of 50 feet. Most statutes and ordinances use that distance as a standard; it tends to integrate the sound from all parts of the vehicle into a total. In many situations it may not be possible to measure at that distance and Table C-6 provides adjustments for differing measurement distances.

The three major categories are trucks, motorcycles, and automobiles; the latter category is generally described as any vehicle not fitting the first two categories. The sound from vehicles increases about 12 dB for every doubling of speed, so most jurisdictions create two speed categories. Since 35 mph is fairly standard on local community streets it is most often used as the separation speed.

One argument used to avoid quieting vehicles was that it was not technically possible. The lowest levels in the table, reflecting existing laws, indicate that such levels are possible. So any proposed ordinance limit at, or above, the lowest level is technically achievable.

## B.2 City Ordinances

Many cities have vehicle sound limit ordinances. Some are required to be approved by the state and other are required to be at least as strict as state statute. Table B-2 shows examples many of them; it is necessarily incomplete. The table is formatted in the same way as Table B-1: the measurement distance is presumed to be 50 feet, and the speed separation is 35 mph.

Community	Less than 35 mph					More than 35 mph				
	Trucks			Cars	Motor cycles	Trucks			Cars	Motor cycles
	6K	8K	10K			6K	8K	10K		
Albuquerque, NM	87		88 <sup>6</sup>	80	69 <sup>7</sup>	87		88 <sup>6</sup>	80	69 <sup>7</sup>
Anchorage, AK			86	80	76			90	80	80
Billings, MT			82	74	74			82	74	74
Boulder, CO	80 <sup>1</sup>	80 <sup>1</sup>	80 <sup>1</sup>	80		80 <sup>1</sup>	80 <sup>1</sup>	80 <sup>1</sup>	80	
Boulder County, CO	80	80	86	80	80	84	84	88	84	84
Broward, FL		94		82	88		96		88	92
CA cities	State Law applies									
Chicago, IL		86		76	82		90		82	86
Colorado Springs, CO <sup>2</sup>	80	80	88	80	80	80	80	88	80	80
Denver, CO			90	76	76			90	76	76
Oahu, HI	86			73	73	86			83	83
Hammond, IN		86	93	82	86		90	96	86	90
Indianapolis, IN		88		76	82		90		82	86
Kalamazoo, MI	74	74	82	74	74	78	78	86	78	78
Lincoln, NE*			86	76-80	76-80			90	84	84
Madison, WI	80	80		80	80	80	80		80	80
Minneapolis, MN			75 <sup>4</sup>	71 <sup>5</sup>				75 <sup>4</sup>	73 <sup>5</sup>	
New York City, NY		86	86	70	78		90	90	79	82
Omaha, NE	76	76	86	76	82	82	82	90	82	86
Salt lake City, UT <sup>3</sup>			82	74	76			88	78	78

**Table B-2 Motor vehicle limits by city**

\* Lincoln, NE has three speed categories: 25, 40 and greater than 40 mph.

### Superscript index

1. Trucks on trucks routes, or between 7 am to 6 pm, Monday through Saturday 88 dB(A)
2. No allowance for various speeds.
3. Speed limit is 40 mph. The level is corrected to 50 feet from 25 feet.
4. Truck limits are shown in Table B-3 and are based on time-of-day.
5. Automobile speed limits and maximum levels at 50 feet are set according to Table B-4.
6. Night levels are 80 dB(A).
7. Translated from SAE J1287 stationary test to 50 feet.

Time of Day	Speed Limit ≤35 mph	More than 35 mph
Day	75	75
Evening	67	75
Night, Holiday, Sunday	65	75

Posted Speed Limit	dB(A)
25	67
30	69
35	71
40	73
45	75
50	77
55	79
60+	81

**Table B-3 Minneapolis truck level limits**

**Table B-4 Minneapolis automobile level limits**

### B.3 Maximum Level Adjustment Based on Different Posted Speed Limit

Many existing ordinances are based on a posted speed limit of 35 mph. An ordinance maximum level can be chosen based on 35 mph from other ordinances. However, if the posted speed limits in the community are different than 35 mph, Table B-5 can be used to insert a maximum level at the differing posted speed limit that is consistent with the levels for the 35 mph limit. The table is based vehicle sound increasing with the 4<sup>th</sup> power of speed. Note that the levels in Table B-4 agree reasonably well with those in this table.

**Example:** 80 dB(A) at fifty feet was chosen as a maximum for posted speed limits less than 35 mph. If the posted speed limit is 45 mph then 84 dB(A) would be an equivalent maximum level.

There is a weakness using the “less than” criterion for just one posted speed limit. In the example above, a vehicle going just 10 mph would be permitted to make 84 dB(A) as opposed to the 80 dB(A). The lower the posted speed limit, the quieter the community. Minneapolis (Table B-4) uses a number of speed categories which can be practical since monitoring on a specific road will have a known speed limit.

Another advantage of more speed categories is that high sound levels are generally associated with speeding over the posted limit.

Posted Speed Limit	Correction to 35 mph Level, dB(A)
25	-6
30	-3
35	0
40	+2
45	+4
50	+6
55	+8
60	+9

**Table B-5 Limits for other  
posted speeds**

## B.4 Operating vs. Stationary Sound Limits

There are two types of tests that can be performed on motor vehicles of all types, including road vehicles, off-road vehicles, snowmobiles and watercraft.

*Operating* measurements can be made from a monitoring station near a vehicle path. The measurements can be unknown to the vehicle operator or can be a required test. The Society of Automotive Engineers (SAE) has published a number of test procedures; a list is given in Appendix D. They require strict conditions for making such measurements. The distance has been standardized to 50 feet; that distance is used in most federal, state, and local laws.

There are a number of situations where the vehicle is stationary; e.g., at a repair shop where a muffler has been changed. Another reason for a stationary test is that the vehicle was too remote to make a 50 foot measurement. Stationary measurements are made close to the vehicle exhaust, with the presumption that the engine exhaust is the primary sound source. The vehicle is stationary and the engine is run at high RPM. SAE test procedures (e.g., J1287) require the distance to be 20 inches (0.5 meter). For example, New Hampshire requires a stationary test limit of 106 dB(A) which translates to 76 dB(A) at 50 feet under the most stringent conditions of engine RPM.

Stationary Test Levels	Estimated Operating Test Levels
120	90
115	85
110	80
105	75
100	70
95	65
90	60

***Table B-6 Stationary vs. Operating test levels***

If an official wishes to have both sets of tests in the ordinance, how to set the two sound levels so they are equitable? Table B-6 shows some comparisons of levels at the two distances based on inverse square sound spreading. Essentially, there is a 30 dB difference.

The value a stationary test is that the vehicle creates its highest sound level, while operating tests can occur under a variety of conditions. Operators of unmuffled motorcycles are keen at observing noise monitoring sites and take their foot off the accelerator until they are past.



## Appendix C

# Technical Aspects of Sound Measurement

*This chapter contains descriptions of the technical aspects of sound measurement. Much of the material is background information not critical in enforcing a noise ordinance, but is helpful to understanding the underpinnings of measurement to enable response to questions about what is measured by violators or their attorneys. It also includes tables that may be used for correction of measurements.*

### C.1 Sound, Vibration, and Noise

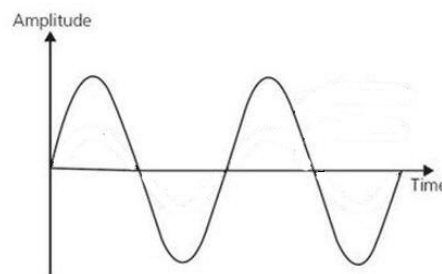
**Sound** is a pressure wave that propagates in a material medium. We are primarily concerned with the air medium where our ears are located. There are pressure waves that are not sound. Stick your ear out the window of a moving car; your ear will detect the changing pressure of the air flow but it is not sound because it does not propagate to distant locations where others can hear it. Microphones on sound level meters measure sound with one possible exception. When wind passes over a microphone, it will generate pressure changes that the meter will interpret as sound, but it most emphatically is **not**. Although wind may not artificially increase readings in most cases, it is legally safe to ALWAYS USE A WIND SCREEN. See the Wind Speed Section in Chapter 7.

**Vibration** of solid and liquid materials can contain both sound and non-sound waves and can result in sound in air that a person can hear. The vibratory motion can vibrate other objects in a listener's room and may also be felt. Vibration results in three forms of waves: (1) the sound that is heard; (2) the vibration that is felt; and (3) the sympathetic motion of other objects. If vibration is an issue, a noise ordinance provision must be written to cover these aspects.

**Noise** is defined as *unwanted sound* (or *vibration* in this context). It is a subjective evaluation of the desirability of the sound and thus *cannot be measured*! The conversion of sound to noise must be done within a noise ordinance by creating standards that are based on the adverse health and welfare effects of sound. Note that the word "sound" is used throughout the ordinance, since it is enforcement of the law that converts that sound to noise.

### C.2 Measurement of Sound

A sound wave is a time-varying change of pressure around atmospheric pressure, so the measurement process has to remove the steady atmospheric pressure as well as provide a means of avoiding cancelling the positive part of the wave with the negative. It has two characteristics important for a noise ordinance: its amplitude (loudness) and its frequency or frequency spectrum (multiple frequencies). One step in removing the atmospheric pressure is by having both sides of the microphone open to the air. With no sound there is no signal. The figure on the right shows a sound wave signal on a microphone at a single



**Figure C-1. A pure tone wave**

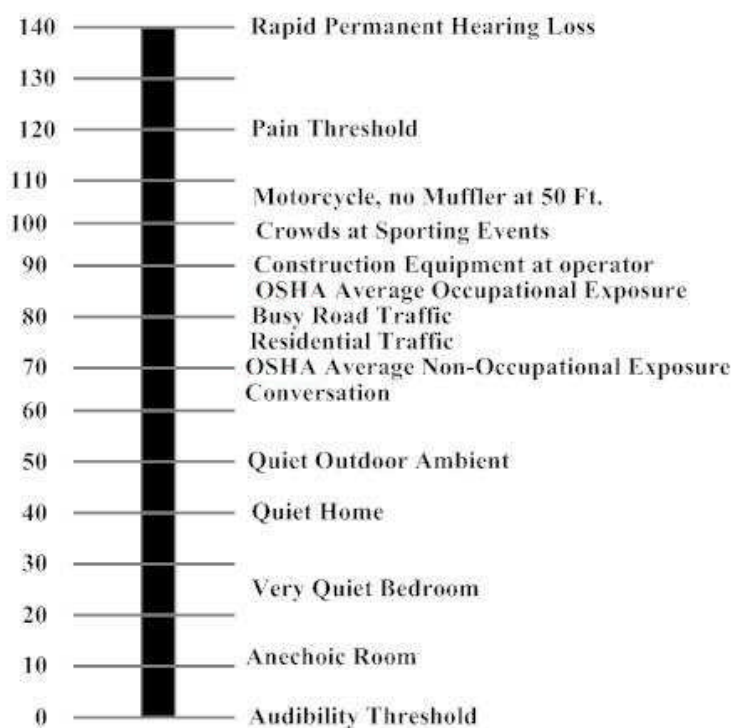
frequency; it is referred to as *sound pressure*. It varies around atmospheric pressure. To get a meaningful measurement the signal is squared so the negatives become positive; first a time average of the totally positive wave is taken and then a square root to undo the squaring. The result is a number representing the average amplitude of the wave. The sound does not have to be at one frequency; it can be completely random without invalidating the results. The important point here is that it takes a finite amount of time to create the average, so there is no such thing as instantaneous sound amplitude. Peak detection is the fastest that can be achieved in normal meters. This is not an issue for noise ordinance enforcement, however.

## C.2.1 Sound Levels

The ear can detect an enormous range of sound pressure amplitudes, the highest about 100 trillion times the lowest. A means was needed to encompass such a phenomenal range and the *decibel* scale was developed. It is a *logarithmic* scale. The ear, the eye and the sense of touch are all logarithmic sensors. For example, a finger can detect the light touch of a hair as well as stand the impact of a hammer. The eye can detect one photon and withstand the sun. Mathematically, the decibel scale converts a multiplication operation to an addition operation. A sound that has 10 *times* more amplitude than the original has ten decibels *added* to the level. The descriptor changes from psi to dB. The decibel (dB) is named in honor of Alexander Bell. Originally, it was called the Bel, but was not detailed enough, so it was divided into ten parts, the deciBel. The converted *sound pressure* is referred to as *sound pressure level*. Acoustics uses the metric system so pounds per square inch (psi) is replaced by Newtons per square meter. The equation for the conversion is shown in Figure C-2. The upper term in the brackets is the time average of the square of the sound pressure (or its square root). The lower term is a reference pressure that has been set to 0 dB, the threshold of hearing. The reference pressure is 20 micro-Pascals.

$$L_p = 20 * \log_{10} \left[ \frac{\sqrt{p_{avg}^2}}{\sqrt{p_{ref}^2}} \right] = 10 * \log_{10} \left[ \frac{p_{avg}^2}{p_{ref}^2} \right]$$

**Figure C-2. Calculating sound levels**



**Figure C-3. Approximate sound levels**

Figure C-3 shows some examples of sound levels. The numbers are only approximate; they depend on the weighting filters used and most levels will vary depending on distance. For example, the ambient inside a home can range from 25 to 45 dB(A). Outdoor ambient levels can vary from 40 to 80 dB(A)

depending on location. The figure is intended only to show the broad level range of human hearing and the examples shown **cannot** be used for a noise ordinance.

To put this range in perspective consider the impact of an unmuffled motorcycle passing by a person asleep near an open window. The level difference at passby can be as much as 50 dB! The sound energy impact is 100,000 times that of the ambient.

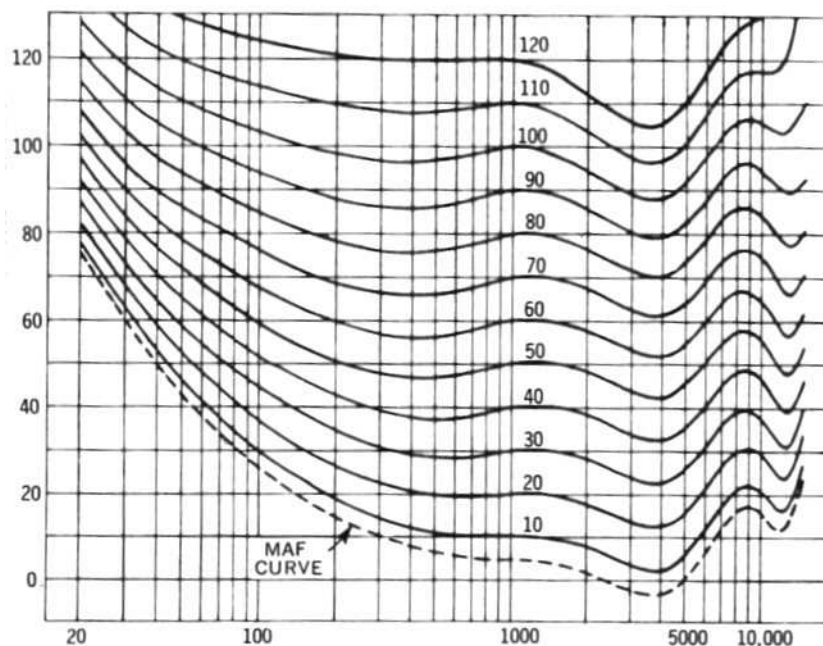
**Important:** Addition of sound levels is not normal addition. 30 + 40 dB does **not** equal 70 dB. Only sound energy can be added. For example,  $10^3$  (30 dB) +  $10^4$  (40 dB) =  $10^{4.04}$  (40.4 dB). 70 dB is  $10^7$ , much larger.

Another point is that sound reduction should never be given in percent reduction, which is sometimes done to justify a noise reduction effort by a violator. For example, if it is claimed that the sound level was cut by 50%, it would mean a 3 dB reduction, just barely detectable.

### C.2.2 Sound Frequencies

The frequency of sound can range from subsonic to ultrasonic. The descriptor is called Hertz (Hz) in honor of the German physicist Heinrich Hertz, who made important scientific contributions to the study of electromagnetism. The range of frequencies people hear not only is more limited but the sensitivity to each frequency is different. A sound is considered a *pure tone* if it contains only one frequency. A police whistle is an example. Other sounds contain a single base frequency (*fundamental*) but with *overtones* that are multiples of the base frequency. Sounds from musical instruments are examples. Yet other sounds have a continuous distribution of frequencies (*frequency spectrum*), typically called *broadband* or *random sound*. Never use *white noise* as a description as it is not only incorrect, but is only a theoretical concept. The response of people to pure tones or nearly pure tones is considerably stronger than that for random sound at the same level so noise ordinances have to take this into account.

A graph of the *sensitivity* of the *normal* human ear is shown in Figure C-4. People hear best around 4000 Hz. We hear poorly at 20 Hz and above 15,000 Hz (15 kHz). It is clear that the ear is very sensitive to sound between 500 Hz and 6000 Hz. This range is where most tones occur, warranting concern about control of pure tones. The curves in the graph are called *Phon* contours and relate to the *loudness* of sound. MAF stands for *minimum audible frequency*.



**Figure C-4. Frequency response of the human ear**

### C.2.3 Weighting Filters

To account for the variable sensitivity of the human ear to each frequency, *weighting filters* were designed to take this in account. Two of the most used filters are shown in Figure C-5. When these networks are used, each band of frequencies is adjusted in level as per the graph and then summed to create the overall level. When *frequency filters* are used, each frequency has zero (flat) weighting over all frequencies. The levels in each band are reported individually (See next section).

The A-Weighting filter was designed to match the ear's response to lower sound levels. It is most applicable to community noise and is commonly used for noise ordinances. The C-weighting filter was designed to match the ear's response to much higher levels and is not applicable to the usual levels of sound found in a community. Chicago, IL and some other communities requires measurements using this weighting. As can be seen in the figure, low frequencies add significantly to the overall level, so C-weighted levels are always higher than A-weighted levels. Heavy industry and some large vehicles generate considerable low frequency sound. Bass notes from vehicles sound systems or from places of public entertainment also contribute to low frequency sound. C-weighting may be appropriate for these types of situations while A-weighting filter are best for other situations. It is possible to have both weighting filters as part of a noise ordinance provision. Some communities use frequency filters to handle low frequency sound.

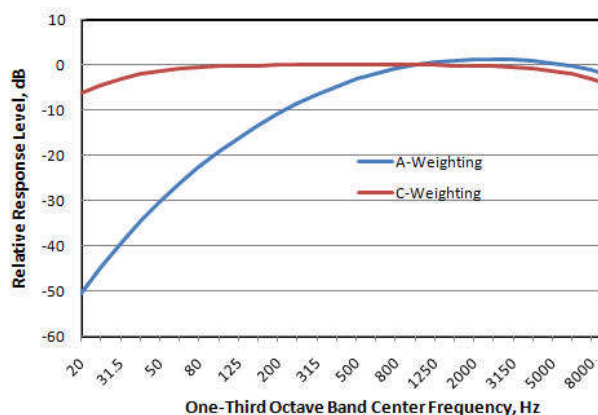


Figure C-5. A and C frequency weighting filters

### C.2.4 Frequency Filters

To capture a pure tone objectively, a frequency filter is required. It determines the narrow range of frequencies of the tone, but it also measures the level in that range. Commonly used frequency filters have frequency bands one octave wide (the upper end of the band is twice the frequency of the lower end), or one-third octave wide, so it is not possible to determine the *exact* frequency. One-third octave band filters provide three times more information than one octave band filters. Since the human ear is similar to a one-third octave band filter, the lack of exactness in determining the frequency is not a legal issue. Filters are useful to determine the frequency distribution of a particular sound, if that is needed. Although some communities require *spectrum analysis* in their ordinances, most noise ordinance enforcement does not require such detailed information. The meters containing this

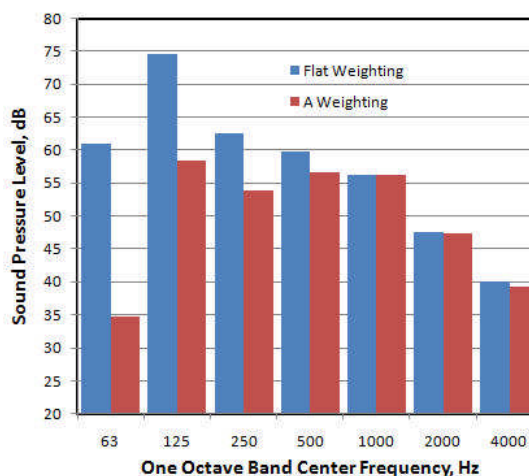


Figure C-6. Flat and A-weighted frequencies

capability are more expensive.

Figure C-6 shows the flat-weighted one-octave band analysis of a quiet motorcycle (blue), showing the prominent tone at 125 Hz; it is about 15 dB above the levels at the other frequencies. Its prominence clearly makes it a pure tone. The remaining part of the frequency spectrum is due to broad band sound. The problem with using frequency filters for all measurements is that, for the example in the figure, there are 7 numbers to process and evaluate as opposed to one with A-weighting. Ordinances with provisions for frequency filters require that each of the numbers be compared with a limit given in a table. See Noise Rating Contours below. If the measured number in any band is greater than the limit number the source is in violation. It is recommended that this method be used only with high level and difficult sound sources.

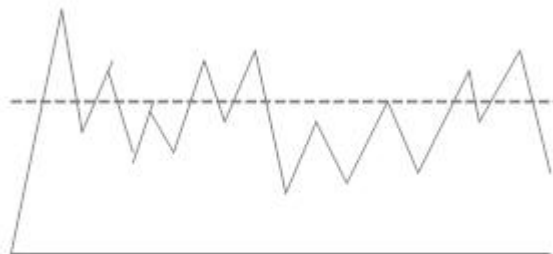
The A-weighting network was applied to the data and is shown as red in Figure C-6 to the right of the flat weighted data. The prominence of the tone is greatly reduced. Had the tone occurred at 1000 Hz, the tone would have stayed just as prominent. The point is:

**Do not use A-weighted measurements to identify a pure tone unless the source can be turned on and off.**

### C.2.5 One Method of Capturing Time-Varying Levels ( $L_{eq}$ )

Anyone making an enforcement measurement will appreciate that many sound sources change level with time. How to handle this? It is tempting to simply read the highest level obtained as the one to compare with the fixed level ordinance limit. Although some ordinances are that strict, they are seldom defensible.

One method is to manually add up the time the ordinance limit was exceeded and calculate an average; not a simple task. A better method is to have the meter capture A-weighted sound levels in short increments of time (e.g., one second). This requires a meter that can capture levels, at one second intervals, over a specified time period (an hour or 24 hours), then store and process the data. The level data are added on an *energy*



**Figure C-7. Energy averaging sound levels**

basis and then averaged over the measurement period to arrive at a sound level which, if constant over the period, would have the same energy as the varying levels. The jagged solid line in Figure C-7 represents varying levels with the same sound energy as the dotted line which represents the equivalent constant sound. The averaging process is weighted toward the higher levels so is a fair representation of the *overall* sound impact during that period. This is a useful tool for noise ordinance enforcement of stationary sound sources. If the Energy Equivalent Sound Level ( $L_{eq}$ ) is greater than the maximum of the ordinance, it is in violation. Note that the measurement period should be stated either in the ordinance or in a policy. The symbols  $L_{eq}(h)$  or  $L_{eq}(24h)$  is often used as a shortcut to designate a measurement period of one hour or twenty four hours respectively. Many meters on the market have this capability.



## C.2.6 Another Method of Capturing Time-Varying Levels ( $L_x$ )

How does one handle an ordinance provision that states “the sound shall not exceed the maximum more than X minutes per hour”? Calculating the  $L_{eq}$  will not yield the required time information. The method in this section also captures increments of the time-varying levels but processes them differently. There are many meters that are capable of doing this task.

Each level that is captured is added to a level bin, so at the end there is a table denoting the number of times a particular level was recorded. An example for a random sound is shown in Figure C-8. The lowest level during the measurement period was 30 dB(A) and it occurred only once. The highest level was 71 dB(A) and that only occurred once. The most frequent level was 51 dB(A) and that occurred 20 times. For this type of measurement A-weighting is used. To make these data useful, we ask the question: What percent of the time was a particular level exceeded? 30 dB(A) was exceeded 100 percent of the time while 71 dB(A) was never exceeded. To get intermediate results, the number of events is added up from the highest level downward. To make the data more user friendly, it is normally presented in the format of the sample graph shown in Figure C-9. If an ordinance provision states that the number X shall be 12 minutes or less in an hour, then the maximum level cannot be exceeded more than 20 percent of the time ( $12 \times 100 / 60$ ). From Figure C-9 it appears that 51 dB(A)  $\{53 + 49\} / 2$  is the value to be compared with the maximum level. In practice, the actual percent in the ordinance provision can be chosen on a good meter and read directly from the meter without all this graphing. The points in the graph are called percentile levels and denoted  $L_x$ . For example  $L_{50} = 47$  dB(A).

The strength of this method is that it permits a statistical determination of the ambient level ( $L_{90}$ ), and the impact level ( $L_{10}$ ) with one set of measurements. See definitions 3.25 and 3.48 in Chapter 5. The weakness of this method is that it takes time to accumulate the data, it requires a special meter, and does not determine what created the sound (ambient or source). This latter point can be an issue. It is common to think that the ambient is sound made by everything but the source which needs to be measured. If a source is sufficiently loud, it will create the ambient measured by this method. Since much of a listener’s disturbance is based on

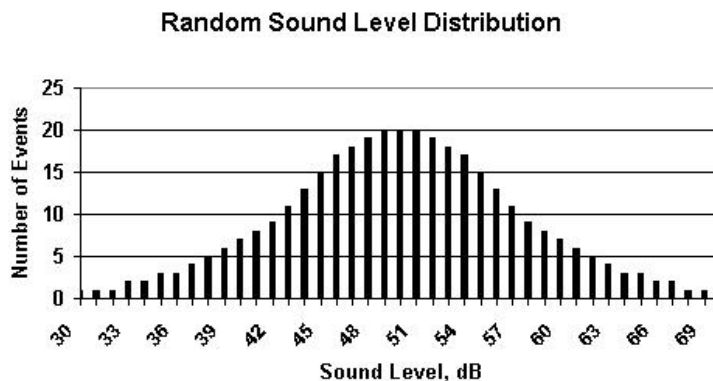


Figure C-8. Level distribution of random sound

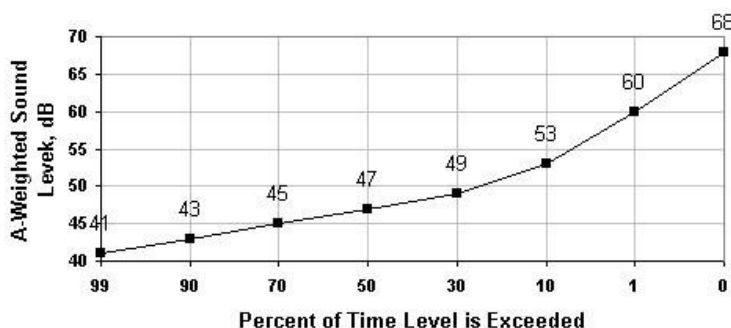


Figure C-9. Percentile level graph

the levels above ambient, such as  $L_{10}$ - $L_{90}$ , this method can determine that. However, if the  $L_{90}$  is created by the source itself and is well above reasonable levels, it also creates a negative impact. This method is best applied to time-varying stationary sound sources that are on continuously, but whose  $L_{90}$  is below reasonable fixed maximum limits found in an ordinance.

### C.3 Interference from Ambient Sounds

One difficulty in measurement is to separate the source to be measured from all the other sounds. How much do the other sounds add to the level of the sound of interest? In the Sound Levels section it was pointed out that sound level addition is not normal. There are two ways the sound of interest can be extracted from the sum of the two sounds (source + ambient) without extra mathematics.

If the source of interest *can be turned off*, then the ambient can be measured independently. With the source on, the total of the source sound and ambient is measured. If the ambient and the total have a reasonably constant level, an “eyeball” average may be acceptable, especially if the total is considerably higher. If the ambient and the total vary in level, the method of C.2.5 is recommended ( $L_{eq}$ ). The difference between the two measurements can be used to determine the source sound level by use of Table C-1. Enter the left column of the table with the difference between the total level and the ambient. Read to the right and subtract that number from the total.

**Example:** Total Level = 58 dB(A) and Ambient Level is 53 dB(A). The difference is 5 dB. This results in a correction of 1 dB, so the source level is 57 dB(A).

No correction is needed if the difference is greater than 10 dB. If the difference is 3 dB or less, the ambient is either the same as the source, or greater. That is, the source may not be in violation if a relative level provision is being enforced. Noise complaints are not likely in this case.

If the source *cannot be turned off* during the measurement period, another method can be used to get the correct levels. Measurements can be made at two different distances. The closer distance will be at a higher level and high enough so that the ambient does not interfere. A simple way to determine this is for the observer to close his eyes and if he can clearly point at

the source, the interfering ambient sound is not important. The closer measurement will be free of interference but at the wrong distance. A measurement at the further, proper, distance will have interference from the ambient. It is necessary to measure the closer level free of ambient at the closer distance  $R_1$  and the further distance  $R_2$ , with ambient interference. The two distances are entered into Table C-2 for the correction to give the source level at the proper distance that would exist if there were no ambient. A little tedious but useful.

Difference Between Total Level and Ambient Level $L_t - L_a$	Subtract from Total to Get Source Level
10	0
9	1
8	1
7	1
6	1
5	1
4	2
3	3
2	4
1	5

**Table C-1. Correction for ambient interference if source can be turned off**



**Example:** A level of 75 dB(A) was measured at 30 feet ( $R_1$ ) where no ambient interference was detected. The distance of the property line from the source was 65 feet. Going across on the 30 foot row to 65 feet shows the correction is -7 dB, so the source level would be 68 dB(A) at 65 feet.

R1										R2													
	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	
10	-4	-6	-8	-10	-11	-12	-13	-14	-15	-16	-16	-17	-18	-18	-19	-19	-20	-20	-20	-21	-21	-22	
15		-2	-4	-6	-7	-9	-10	-10	-11	-12	-13	-13	-14	-15	-15	-16	-16	-16	-17	-17	-18	-18	
20			-2	-4	-5	-6	-7	-8	-9	-10	-10	-11	-11	-12	-13	-13	-14	-14	-14	-15	-15	-16	
25				-2	-3	-4	-5	-6	-7	-8	-8	-9	-10	-10	-11	-11	-12	-12	-12	-13	-13	-14	
30					-1	-2	-4	-4	-5	-6	-7	-7	-8	-9	-9	-10	-10	-10	-11	-11	-12	-12	
35						-1	-2	-3	-4	-5	-5	-6	-7	-7	-8	-8	-9	-9	-10	-10	-10	-11	
40							-1	-2	-3	-4	-4	-5	-5	-6	-7	-7	-8	-8	-8	-9	-9	-10	
45								-1	-2	-2	-3	-4	-4	-5	-6	-6	-6	-7	-7	-8	-8	-9	
50									-1	-2	-2	-3	-4	-4	-5	-5	-6	-6	-6	-7	-7	-8	
55										-1	-1	-2	-3	-3	-4	-4	-5	-5	-6	-6	-6	-7	
60											-1	-1	-2	-2	-3	-4	-4	-4	-5	-5	-6	-6	
65												-1	-1	-2	-2	-3	-3	-4	-4	-5	-5	-5	
70													-1	-1	-2	-2	-3	-3	-4	-4	-4	-5	
75														-1	-1	-2	-2	-2	-3	-3	-4	-4	
80															-1	-1	-1	-2	-2	-3	-3	-4	
85																0	-1	-1	-2	-2	-3	-3	
90																	0	-1	-1	-2	-2	-2	
95																		0	-1	-1	-2	-2	
100																			0	-1	-1	-2	

**Table C-2. Correction for ambient interference if the source cannot be turned off**

Another approach is to move to another area where the source of interest has no impact. If the new location has similar environmental conditions as the location of interest (buildings, roads, trees), it is likely that the ambient will be the same. See the Measurement Distance section in Chapter 7.

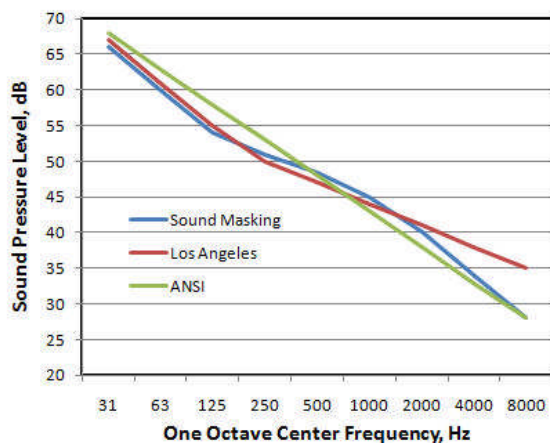
## C.4 Evaluating the Spectrum with Ambient Interference

Alternative 6 of Article IX allows for a method to evaluate the disturbance potential of a sound source in the presence of ambient sound. It requires a sound level meter that can measure octave bands from 31.5 to 4000 Hz. This procedure should be applied to a *broadband* and nearly *constant* sound source where there is a possibility that the ambient sound may interfere. The A-weighted sound level containing both the ambient and the source of interest is measured as well as the noted octave band levels. The A-weighted level is rounded up to a value in Table C-3. The applicable frequency spectrum is chosen from the relevant column. Each measured octave band is compared with the levels in the correct table column. If any measured band is 5 dB greater than the band in the column, the source is in violation.

The concept embedded in this procedure is based on the observation that certain sound spectra are considered “normal” by listeners. See the discussion of Psychological Effects in Chapter 3. The particular spectrum chosen for inclusion in Table C-3 is based on an ANSI standard for a “neutral” contour; it decreases by 5 dB for every octave increase. A similar spectrum is also used when sound masking systems are installed in open offices; it has been found to be the most acceptable. The Los Angeles code (Appendix A) has a similar method and uses a spectrum based on outdoor ambient spectra. A comparison of the three spectra is shown

in Figure C-10. The purpose of this procedure is to determine whether the source of interest has created an undesirable spectrum *despite* the actual overall sound level.

A	35	40	45	50	55	60	65	70	75
31.5	53	58	63	68	73	78	83	88	93
63	48	53	58	63	68	73	78	83	88
125	43	48	53	58	63	68	73	78	83
250	38	43	48	53	58	63	68	73	78
500	33	38	43	48	53	58	63	68	73
1000	28	33	38	43	48	53	58	63	68
2000	23	28	33	38	43	48	53	58	63
4000	18	23	28	33	38	43	48	53	58



*Figure C-10. Most desirable environmental sound spectrum*

**Table C-3. Evaluating a frequency spectrum based on A-weighted measurements**

## C.5 Evaluating Interference from Reflections

Reflections are interfering sounds fundamentally different than those from other sources: *the reflected sound is from the source itself*. One approach is based on noise impact (*immission*) not source output (*emission*), which is the primary focus of a noise ordinance:

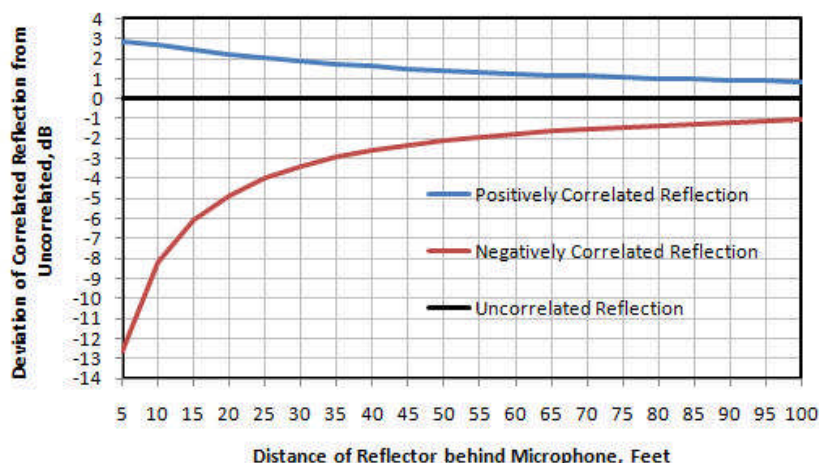
*Although it seems fairly standard to correct for reflections, especially in vehicle monitoring, it must be remembered that the reflection is simply another attribute of the source. So if the measurement location is representative of a listener's position, no reflection correction should be made.*

A counter argument for vehicle monitoring is that the reflection environment continuously changes because of the movement, so the noise impact changes and thus it is unfair not to correct for it. Reflection corrections are done for most vehicle monitoring and are recommended. **No reflection corrections are recommended for stationary sources.**

The reflected sound is correlated to the direct sound; the rules of addition and subtraction are **not** the same as for unrelated sounds. If two sounds are unrelated (other sources) the sum is always greater than either sound. If they are of the same level and unrelated, the sum is 3 dB higher than either. If two sounds are positively related (both identical) the sum is 6 dB higher than either. This can be a problem. However, if they are negatively related (same amplitude but of opposite sign) one would cancel out the other, yielding no sound. Of course, that is the principle used in noise cancelling headphones.

The first reflection of interest is that from the *ground*. It is present for measurements of both stationary and moving sources. In vehicle monitoring, corrections generally are made for the various types of ground surfaces, but they are only applicable to establishing sound *emission* levels. In community noise ordinance enforcement, concern is with noise impact (*immission*) and ground reflection adds to that impact, so no correction is recommended.

The other reflection of interest is that from a *large, flat, hard surface at right angles to the line between the microphone and the source of sound (worst case)*. Measurement of a passing vehicle made on an urban sidewalk with a large building directly behind would be an example. The reflected sound is diminished in level but it is also delayed. The time aspect plays an important role for moving sources and reduces the impact of the reflection. If the sound being measured is close to a pure tone, the reflected sound can be positively or negatively correlated with the direct sound. An example of the potential influence is shown in Figure C-11 for a microphone 25 feet from the source. The comparison is with the correction from an uncorrelated reflection. A reflection from a surface very close to the microphone can increase the reading as much as 3 dB or practically cancel the reading totally. The point here is that measurements of vehicles with nearly pure tones should be done in relatively clear areas (See Figures 10-3 and 10.4 in Chapter 6). This is, of course, a *worst case scenario* which occurs rarely and can be protected against by having the microphone about 50 feet in front of the reflecting surface.



**Figure C-11. Effect of sound reflections based on correlations**

done in relatively clear areas (See Figures 10-3 and 10.4 in Chapter 6). This is, of course, a *worst case scenario* which occurs rarely and can be protected against by having the microphone about 50 feet in front of the reflecting surface.

### C.5.1 Reflection Correction Table

If a large, flat, hard surface is perpendicular to the line from the microphone to source (worst case) and the sound source has many frequencies, the reflection correction in Table C-4 may be used. Most evidence suggests that the normal method of accounting for reflections seems to hold by assuming the reflection is unrelated to the source. The distance correction given in Table C-4 can be used for broadband sound (and most other sounds) reflected from a large, flat, hard surface. For normal reflection distances, the correction is small. If the reflecting surfaces are large, flat, and

Distance reflecting surface is behind measurement position, feet	Subtraction from measurement, dB
Less than 10	Do not measure
10 to 15 (not recommended)	-2
15 to 50	-1
Greater than 50	0

**Table C-4. Level corrections for large flat reflecting surfaces**

hard but at an oblique angle no correction is needed. If the reflecting surfaces are positively curved, such as the exterior of an automobile, the sound is scattered and the correction is negligible. If the surface is negatively curved, like a parabolic reflector, avoid the measurement. The violator can raise substantial objections. Bushes and trees have significant reflections only at higher frequencies and the sound is scattered so the correction is negligible.

## C.6 Evaluating Speech Interference

One aspect of a person claiming noise disturbance is interference with their conversational speech. Holding a conversation at the source of the complaint and determining the distance at which the conversation is easily understood, can be used as a means for evaluating that disturbance. It is called a *walkway test*. Two levels of speech can be used. Normal (conversational) levels are applicable to domestic circumstances, both indoors and outdoors. Raised levels are applicable to public spaces.

If outdoors, create a line that runs at *right angles to the sound source* (so the sound levels on the line remain about the same). This is not necessary indoors. Have a person read material slowly and clearly at normal speech levels while the listener slowly walks away until it is difficult to understand. If the listener has to be close, it is best to use a raised (about 6 dB higher) voice. The relationship of distance to the *approximate* A-weighted sound level is given in Table C-5. The table presumes that the talker's speech spreads out as in open space, and the spectrum of the intruding sound is broadband. The results are **not** accurate in small rooms where reflections change the way sound decays with distance. It should not be applied to *intruding* speech or musical sounds as the interference continually changes in level.

Even with these caveats, the walkaway test can be used to quickly estimate the sound level experienced by an outdoor listener for comparison with maximum permitted sound levels in the noise ordinance. Not only is the amount of speech interference determined, but the intruding sound can be closely estimated without a sound level meter. See Figure 3-1 in Chapter 3.

Most persons in a domestic environment accept 10 to 15 feet as a reasonable distance for holding a conversation outdoors. Use of this method permits establishment of a noise disturbance as well as a violation of an objective noise provision. The distance supports the recommended limit of about 55 dB(A) as a maximum limit for outdoor residential land use. Accepted indoor

Distance, Ft.	At Normal Level Speech	At Raised Level Speech
	dB(A)	dB(A)
1	73	79
2	69	75
3	64	70
4	62	68
5	60	66
6	59	65
7	58	64
8	57	63
9	55	61
10	54	60
11	53	59
12-14	52	58
15-16	51	57
17-18	50	56
19-21	49	55
22-23	48	54
24-26	47	53

**Table C-5. Estimating A-weighted sound levels based on distance to understand speech**

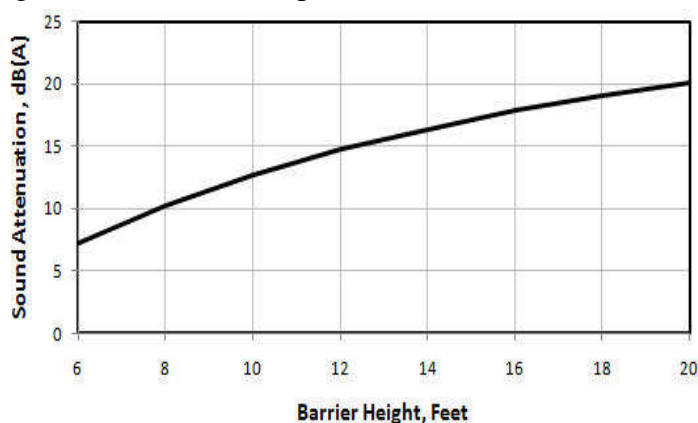
ambient levels range from 35 to 45 dB(A). A building sound level reduction of 10 to 15 dB suggests the desirability of 55 dB(A) as a maximum outdoor limit.

The above applies for intruding broadband sound. An intruding pure tone is always plainly audible and clearly a disturbance. Intruding speech is a disturbance if parts of it are intelligible. Intruding music is a disturbance if the rhythm can be heard.

## C.7 Evaluating Barrier Sound Loss

One means of mitigating the noise impact across property lines is to erect a solid barrier near the line (e.g. highway barriers). When a sound measurement shows that the level is above the maximum, a potential offender may propose a variance to build a barrier. For sound sources well above ground level, 10 or more feet, a property line barrier is not a practical solution; a closer barrier or an enclosure is needed. When the source is near ground level, acceptable sound loss can be achieved with such a barrier. Figure C-12 is an example for a sound source with a typical broadband sound spectrum less than 10 feet above ground level and 50 feet from the property line. The listener is 20 feet beyond the property line. Under these conditions, even a *solid* 6 foot high barrier can provide a significant benefit. The point here for an NCO is to look at the magnitude of the sound excess and determine whether a reasonable sound barrier would bring the source into compliance by referring to the graph. In no case should any recommendation for barrier height be given.

The presence of a sound barrier at the property line provides shadowing of the sound so a measurement there will not be as high as at other points on the affected property. Modeling suggests that after a barrier is erected, measurements should be made 20 feet from the property line.



**Figure C-12. Estimating the loss of sound over a barrier**

## C.8 Correcting Levels for Different Vehicle Measurement Distances

If a standard measurement distance is required by the ordinance for vehicles, but cannot be achieved in practice, it is possible to correct the measured level to what would have been measured at the required distance. Table C-6 shows useful corrections provided that there are no intervening structures, such as barriers. Connecticut and other states use this table for distance corrections.

**Example:** The maximum level of a passing motor vehicle was measured to be 85 dB(A) at 25 feet. The ordinance calls for 50 foot measurements. The corrected level is 85 - 6 or 79 dB(A)

Measurement Distance, Feet	Correction to get 50 foot level, dB.
10	-14
15	-10
20	-8
25	-6
30	-4
35	-3
40	-2
45	-1
50	0
55	1
60	2
65	2
70	3
80	4
90	5
100	6

*Table C-6. Level corrections for measurement distances*

## C.9 Correcting For Different Measurement Errors

A number of provisions require measurements at certain distances. For example, a off-road vehicle shall not be in violation of land use provisions within at 100 feet of a residence. There are times when that distance requirement cannot be met. To avoid complicated level adjustments, it is recommended that the actual distance be reduced to ½ or ¼ of the required distance and Table C-7 be used.

**Example:** The ordinance states that the maximum level is 55 dB(A) at 100 feet. The distance was reduced to one half. A measurement of 65 dB(A) was made at 50 feet. The measurement must be reduced by 6 dB to yield 59 dB(A) at 100 feet. The source is in violation.

Distance	One-Half	One-Quarter
Level Correction	-6 dB	-12 dB

*Table C-7. Corrections for fractional measurement distances*

It is not always possible to get the exact distance correctly. Lane widths on roads tend to be 12 feet and there are other distances that can be estimated with a 3 foot stride. Given that it is possible to estimate the distance to within 20 feet, Table C-8 can be used to correct the levels measured.



Example: The required distance is 100 Feet and the maximum level the is 76 dB(A). The measurement of 80 dB(A) was made at 91 feet. The correction is -1 dB, so the level was 79 dB(A), a violation.

Required Distance	Distance Error, Feet				
	+20	+10	0	-10	-20
200	1	0	0	0	-1
175	1	0	0	-1	-1
150	1	1	0	-1	-1
125	1	1	0	-1	-2
100	2	1	0	-1	-2
75	2	1	0	-1	-3
50	3	2	0	-2	-4
25	5	3	0	-4	-14

**Table C-8. Level corrections for erroneous measurement distances**

**Note:** This section is **not** applicable to plainly audible enforcement.

## C.10 Using the Noise Rating Contour

Some noise ordinances use the Noise Rating system. If the ordinance provision requires a maximum NR rating, it will require each of the octave band levels shown in Table C-8 to be in compliance, not just the overall level.

Noise Rating Curve	Maximum Sound Pressure Level, dB								
	Octave Band Frequency, Hz								
	31.5	62.5	125	250	500	1000	2000	4000	8000
NR 0	55	36	22	12	5	0	-4	-6	-8
NR10	62	43	31	21	15	10	7	4	2
NR20	69	51	39	31	24	20	17	14	13
NR30	76	59	48	40	34	30	27	25	23
NR40	83	67	57	49	44	40	37	35	33
NR50	89	75	66	59	54	50	47	45	44
NR60	96	83	74	68	63	60	57	55	54
NR70	103	91	83	77	73	70	68	66	64
NR80	110	99	92	86	83	80	78	76	74
NR90	117	107	100	96	93	90	88	86	85
NR100	124	115	109	105	102	100	98	96	95
NR110	130	122	118	114	112	110	108	107	105
NR120	137	130	126	124	122	120	118	117	116
NR130	144	138	135	133	131	130	128	127	126

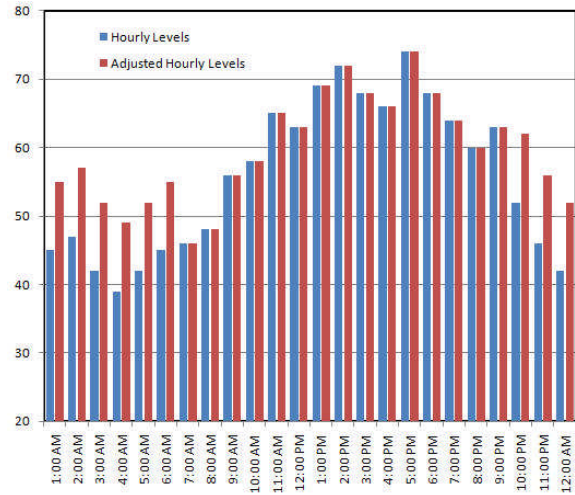
**Table C-9. Using the Noise Rating Contour**



## C.11 Land Use Measures

### C.11.1 Day-Night Average Sound Level ( $L_{dn}$ , DNL)

This measurement determines the *overall* noise exposure, generally over one or more days, and is intended primarily to determine noise impacted areas not noise ordinance enforcement. Twenty-four hourly  $L_{eq}(h)$  values are determined. The actual levels from the 10 pm hour to the end of the 6 am hour have 10 dB added to them to account for the lesser tolerance during night hours. The adjusted levels are then added and averaged. Figure C-13 shows an example of hourly energy average levels in a community; night levels are reduced. The blue bars are the actual levels and the red are the adjusted levels. Because of time and equipment expense, use of this measure is **not** recommended for most communities unless there is a clear case of serious noise impact. Because the adjusted levels at night are considerably less than the actual daytime levels, the Day-Night Sound Level is essentially unchanged at 65 dB(A) for this example.



**Figure C-13. Weighting of frequencies for Day-Night Sound Level**

### C.11.2 Community Noise Equivalent level (CNEL)

CNEL is the Day-Night Sound Level broken into *three* time periods. No correction from 7 am to 7 pm, a 5 dB addition to levels from 7 pm to 10 pm and a 10 dB addition to levels from 10 pm to 7 am. It is the predominant rating scale now in use in California for land use compatibility assessment. These time periods and penalties were selected to reflect people's slightly increased sensitivity to noise during the evening hours. A CNEL noise level may be reported as a "CNEL of 60 dB(A)", "60 dB(A) CNEL", or simply "60 CNEL". It is not useful for noise ordinance enforcement.

### C.11.3 Distances to Meet Common Land Use Limits

Communities have set desired *immission* levels to protect citizens, especially in residential areas. Commonly chosen maxima are shown in Appendix A. There are a number of sources for which the maximum *emission* levels must be set. Examples are motor vehicles of all types, watercraft, and possibly construction sites. The choice of maximum source level will have impact on how far away the desired environmental levels can be achieved. Table C-9 shows the approximate distances required for various source levels and desired environmental levels. It is based on the inverse square law, so applies to totally open conditions. The presence of trees slightly reduce that distance, while buildings and walls can reduce that distance.

Since many sources are omnidirectional, the table distances reflect only the radius. For example, a 1 mile radius implies over 3 square miles of coverage, while a 3 mile radius implies over 28 square miles of coverage!

Source Level at 50 Feet, dB(A)	Desired environmental level, dB(A)			
	60	55	50	45
100	1 mile	1.7 miles	3 miles	5.4 miles
95	0.5 mile	1 mile	1.7 miles	3 miles
90	1600 feet	0.5 mile	1 mile	1.7 miles
85	890 feet	1600 feet	0.5 mile	1 mile
80	500 feet	890 feet	1600 feet	0.5 mile
75	280 feet	500 feet	890 feet	1600 feet
70	160 feet	280 feet	500 feet	890 feet
65	90 feet	160 feet	280 feet	500 feet
60	50 feet	90 feet	160 feet	280 feet

**Table C-10. Distances to achieve desired environmental levels.**

For moving sources, this distance moves with it, while for a stationary source, it is fixed.

### C.11.4 Noise Abatement Criteria (NAC)

The FHWA (Federal Highway Administration) has attempted to create a balance between that which is desirable and that which is achievable. Numerous approaches were considered in establishing the NAC. However, it was speech interference that was usefully applied to the problem of highway traffic noise. Thus, it should be remembered that the NAC are based upon sound levels associated with the interference of speech.

#### Hourly A-Weighted Sound Level – dB(A)

Activity Category	Leq (h)	Description of Activity Category
A	57 (exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (exterior)	Picnic area, fixed recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries and hospitals.
C	72 (exterior)	Cemeteries, commercial areas, industrial areas, office buildings, and other developed lands, properties or activities not included in Categories A or B above.
D	No Limit	Undeveloped lands, including roadside facilities and dispersed recreation.
E	52 (interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums.

**Table C-10. Noise Abatement Criteria.**

23 CFR 772 defines traffic noise impacts as "impacts which occur when predicted traffic sound levels approach or exceed the NAC." The term "approach" has been defined as one dBA less than the  $L_{eq}(h)$  values listed in the table above.

# Appendix D

## Noise Measurement Standards

### Society of Automotive Engineers

These standards apply primarily to the sound *emission* (source oriented) by various products under a number of conditions. Because of the potential legality, the procedures are very detailed and require great care. Noise ordinances are primarily *immission* (listener oriented) standards and many of the restrictions in the standards below are not really relevant to enforcement. For example, many measurements in these standards require a large clear area to avoid sound reflections; this is not necessary for ordinance enforcement. Scientific measurements try to be accurate to 0.5 dB, while enforcement measurements need not be so accurate since level tolerances of a 1 dB, or more, is always made.

#### **J47 Maximum Sound Level Potential for Motorcycles**

An SAE Recommended Practice that establishes the test procedure, environment, and instrumentation for determining the maximum sound level potential for motorcycles under wide open throttle acceleration and closed throttle deceleration.

#### **J192 Maximum Exterior Sound Levels for Snowmobiles.**

An SAE Recommended Practice that establishes the instrumentation, test site, and test procedure for determining the maximum exterior sound level for snowmobiles. Measured sound pressure levels are also highly dependent on the degree of track slip present when performing the vehicle acceleration.

#### **J331 Sound Levels for Motorcycles**

An SAE Recommended Practice that establishes the test procedure, environment, and instrumentation for determining the sound levels of motorcycles under full throttle acceleration and closed throttle deceleration.

#### **J366 Exterior Sound Levels for Heavy Trucks and Buses**

An SAE Standard that establishes the test procedure, environment, and instrumentation for determining the maximum exterior sound level for highway motor trucks, truck tractors, and buses. The test results obtained by this test procedure give an objective measure of the maximum noise level emitted by vehicles under a prescribed condition.

#### **J986 Sound Levels for Passenger Cars and Light Trucks**

An SAE Standard that establishes the test procedure, environment, and instrumentation for determining the exterior sound level for passenger cars, multipurpose vehicles, and light trucks having a gross vehicle mass rating of 4540 kg (GVWR of 10,000 lb), or less. The test procedure is characterized by having fixed initial conditions, i.e., an as-specified initial vehicle speed and gear selection at a fixed start point on the test site. Full-throttle acceleration and closed-throttle deceleration of the vehicle are included in this procedure.

**J1075 Sound Measurement – Construction Site**

An SAE Standard that sets forth measurement procedures and instrumentation to be used for determining a "representative" sound level during a representative time period at selected measurement locations on a construction site boundary. Determination of a representative time period is left to the judgment of the user.

**J1161 Operational Sound Level Measurement Procedures for Snowmobiles**

A recommended practice that establishes the instrumentation, test site, and test procedure for determining the exterior operational sound level for snowmobiles.

**J1175 Bystander Sound Level Measurement Procedures for Small Engine Powered Equipment**

An SAE recommended practice that establishes the instrumentation and procedure to be used in measuring the sound level of engine powered equipment under 15 kW (20 bhp) typical of their normal operation. It is intended to include equipment such as lawn mowers, snow blowers, and tillers. It is not intended to include equipment designed primarily for operation on highways or within factories and buildings, or vehicles such as motorcycles, snowmobiles, and pleasure motorboats that are covered by other SAE Standards or Recommended Practices. This procedure does not cover chain saws. The SAE Recommended Practice may also be used when measuring the bystander sound level on similar equipment powered by electricity or other power sources.

**J1287 Measurement of Exhaust Sound Pressure levels of Stationary Motorcycles**

An SAE Standard that establishes the test procedure, environment, and instrumentation for determining the sound levels of motorcycles under stationary conditions. This test will measure primarily exhaust noise and does not represent the optimum procedure for evaluating total vehicle noise. For this purpose, SAE J331 or SAE J47 is recommended.

**J1470 Measurement of Noise Emitted by Accelerating Highway Vehicles**

An SAE Standard equivalent to ISO Standard 362 - 1997 except for the differences detailed in Appendix A, and includes the modifications adopted by WP 29 in ECE R51 Revision 1 and EEC 92/97 and EEC 96/20. This document specifies an engineering method for measuring the noise emitted by accelerating highway vehicles of all types (except motorcycles) in intermediate gears with full utilization of the available engine power. The method is designed to meet the requirements of simplicity and reproducibility of results under realistic vehicle operating conditions. Measurements relate to operating conditions of the vehicle which give the highest sound level consistent with urban driving and which lead to reproducible sound emissions. Therefore, an acceleration test at full throttle from a stated engine or vehicle speed is specified. The test method calls for an acoustical environment which can only be obtained in an extensive open space. The results obtained by this method give an objective measure of the noise emitted under prescribed conditions of test.

**J1492 Measurement of Light Vehicle Stationary Exhaust System Sound**

An SAE recommended practice that establishes the test procedure, environment, and instrumentation to be used for measuring the exterior exhaust sound level for passenger cars, multipurpose vehicles, and light trucks under stationary conditions providing a continuous measure of exhaust system sound level over a range of engine speeds. This practice applies only

to road vehicles equipped with an internal combustion engine. The method is designed to meet the requirements of simplicity as far as they are consistent with reproducibility of results under the operating conditions of the vehicle. It is within the scope of this practice to measure the stationary A-weighted sound pressure level during: (a) measurements at the manufacturing stage (b) measurements at official testing stations, or (c) measurements at roadside testing.

#### **J1970 Shoreline Measurement Procedures for Recreational Motorboats**

An SAE recommended practice that establishes the procedure for measuring the sound level of recreational motorboats in the vicinity of a shore bordering any recreational boating area during which time a boat is operating under conditions other than stationary mode operation.

#### **J2005 Measurement of Exhaust Sound Levels of Recreational Motorboats**

An SAE recommended practice that establishes the procedure for measuring the sound level of recreational motorboats in the vicinity of a shore bordering any recreational boating area during which time a boat is operating under conditions other than stationary mode operation.

#### **J2567 Measurement of Exhaust Sound Levels of Stationary Snowmobiles**

An SAE recommended practice that establishes the test procedure, environment and instrumentation for determining the sound levels of snowmobiles in the stationary test mode. This test method is intended to provide an accurate measurement of exhaust and other engine noise and may be used to evaluate new and in-use snowmobiles to determine compliance with noise control regulations. Sound level measurements obtained with this test method are not intended as an engineering determination of overall machine noise. For this purpose, the use of SAE J192 is recommended.

#### **J2805 Measurement of Noise Emitted by Accelerating Road Vehicles**

An SAE Standard equivalent to ISO 362-1:2007 and specifies an engineering method for measuring the noise emitted by road vehicles under typical urban traffic conditions. The specifications are intended to reproduce the level of noise which is generated by the principal noise sources during normal driving in urban traffic. The method is designed to meet the requirements of simplicity as far as they are consistent with reproducibility of results under the operating conditions of the vehicle. The test method requires an acoustical environment which is only obtained in an extensive open space. Such conditions are usually provided for during: measurements of vehicles for regulatory certification measurements at the manufacturing stage measurements at official testing stations The results obtained by this method give an objective measure of the noise emitted under the specified conditions of test.

## **American National Standards Institute**

These standards apply to the quality of the sound measuring equipment.

ANSI 1.4 Specification for Sound Level Meters and Supplement ANSI A1.4a-1985

ANSI S 1.6 Preferred Frequencies and Band Numbers for Acoustical Measurements (R 1990)

ANSI S 1.13 Methods for the Measurement of Sound Pressure Levels (R 1986)

ANSI S1.11 Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters 1986

# Appendix E

## Sound Level Meters

Stand alone meters are recommended over computers with microphones. They can be carried more easily, have all features in one cabinet, and can be tripod mounted when necessary.

### E.1 Meter Types

The meter *type* is designated with a number. ANSI (American National Standards Institute) sets meter types. Type 0 meters are highly accurate and generally are reserved for scientific use. Type 1 meters are slightly less accurate, but can withstand any attack on quality when used in noise enforcement. Type 2 meters are slightly less accurate than Type 1 meters but are often good enough to use in noise enforcement. Higher numbered or unnumbered types are **not** recommended. There are a number of commercial meters which claim to be Type 2, but in fact do not meet the type standard. It is best to verify the quality of the meter otherwise it may be contested in court. For international meters, IEC 651 applies; it uses similar type descriptors.

**Type 1 meters are recommended for enforcement against industries where large costs and court action may be possible. For other use, meters *guaranteed* to be Type 2 are recommended.**

### E.2 Microphone Types

When high frequency sound impinges on a microphone it is possible for the response of one part of the microphone to cancel or enhance the response on another part or cause the microphone diaphragm to respond excessively. Microphones are designed to compensate for this. One type is called *free-field* and is intended to be pointed at the sound source and quality microphones will have flat response from 20 Hz to above 10 kHz. The other type is called *random incidence* and is designed to handle sound from all directions. It would seem that this microphone is best applied for ambient measurements while the free field is best applied for source such as vehicles. Since noise ordinance use A or C-weighting, or octave bands up to 8 kHz, the difference between them is not significant; the differences occur only at higher frequencies.

**One-half inch diameter free-field microphones are recommended.**

### E.3 Frequency Weighting Filters

Since the human ear does not respond equally to sound at different frequencies (see Figure 5-5 on Page C-5), sound level meters were developed with filters to adjust (weight) the actual level to that heard by a listener at each particular frequency. Since the response of the ear also varies with overall level, a number of different weighting filters have been developed. The earliest are called A, B, C and correspond to ear response at lower and higher levels,



respectively. There are others, but those are used in more complex measurements than those in noise ordinance enforcement. There is much experience with A-weighting as a noise impact measure. C-weighting can be used beneficially for the impact of low frequency sounds, such as “boom boxes” or large factories. Since quality meters have both filters built-in, the choice of filter is not an issue.

**Meters with A and C weighting are recommended.**

## **E.4 Frequency Spectrum Filters**

There are applications where looking at the frequency distribution of sound energy is useful. The most common filters are *one octave* and *one-third octave*. The meters are often called *Real Time Analyzers (RTA)*. The filters divide the sound spectrum into bands one octave wide (each octave band is double the frequency of the next lower band) or into three bands for each octave. One use of this filter is to define *pure tones*. While a truly pure tone is obvious and no filter is needed to define it, many sources have a base frequency with many harmonics, making it more difficult to create an airtight, defensible definition. In most cases with a source creating a pure tone, the responsible person would have to retain a consultant to define what must be done to meet a noise ordinance. Another use is to define the magnitude of the violation by comparing the level at each frequency band with the level in an ordinance that uses maximum levels in octave bands. Any band that exceeds the limit is a violation. Some noise ordinances set maximum band limits with certain sound spectra are considered more acceptable than others. The spectra many vary with overall levels created enforcement complexity, better definition of a specific noise problem. Use of frequency spectrum filters is generally associated with measurement of large manufacturing facilities. Meters with this capability are more expensive than those without, but may not be prohibitively so. Their use entails considerably more effort.

**If the purpose is only for pure tone identification, spectrum filters are not considered necessary and are not recommended. Except for use in large industrial areas, spectrum filters are not recommended. If they are chosen, octave band filters are recommended as they are sufficiently detailed for enforcement and the work load is reduced compared to one-third octave band filters.**

## **E.5 Meter Response Speed**

There are three basic time response settings in a meter: impulse, fast, and slow. The settings are called *exponential response* (the circuit responds exponentially to a sound that rises to a fixed level). The response of the electronics is fastest with impulse setting (25 milliseconds) and is appropriate to capture impulse sounds having short duration. For FAST (F) response, the meter reaches 63% of its final value in 1/8<sup>th</sup> of a second while the SLOW (S) response takes 1 second. Most meters have both fast and slow response so meter choice is not an issue unless the ordinance requires impulse response.

**Choose a meter with both slow and fast response. Choose a meter with impulse response only if the ordinance calls for such measurements.**

## E.6 Energy Weighting ( $L_{eq}$ )

The meter response speed noted above allows the level to be determined in a short time interval. It is useful for the passing of vehicle, but how does it define the noise impact of a continuous, but varying, stationary sound source? It is now possible with modern meters to capture the short time levels, store them, and sum all of them over a given measurement period. For example, 3600 one second A-weighted readings can be *energy* averaged over one hour period to give a good measure of noise impact. Doing such a task manually by adding up the levels would be ridiculously time consuming and would result in an erroneous result, because the averaging would be *arithmetic*. This method is called Energy Equivalent Level ( $L_{eq}$ ). There are several advantages for noise enforcement. The classic enforcement application is for a sound that fluctuates in time. What is the correct A-weighted reading if the levels keep changing, particularly if the levels only exceed the maximum limit part of the time?  $L_{eq}$  converts the changing levels to an equivalent continuous level for comparison with the ordinance limits. See Appendix C.2.5 for more details. Another advantage is that averaging period can be set by the user. A standard argument by a noise maker is that the measurement was made during the short time they exceeded the limit. A period of one hour is fairly standard to counter that argument. Having a meter with this capability makes the NCO work considerably simpler, provided the noise ordinance has a provision permitting it. The simpler characteristics listed in the above sections are generally also contained in such a meter.

**Purchasing a meter with this capability is recommended for land use noise applications if the ordinance contains provisions for it.**

## E.7 Meter Statistical Capabilities ( $L_x$ )

Many ordinances have provisions such as "...shall not exceed the maximum level more than Y minutes in one hour". For a sound source steady in level but intermittent, only a watch is needed. When the source is continually changing in level, it is much more difficult to manually establish ordinance violation. The Energy Equivalent Level ( $L_{eq}$ ) in E.6, although very useful, does not provide the needed information. A meter that can measure *percentile levels* is needed. (See Appendix C.2.6 for more details). The meter collects sound levels, typically every second, and places the data into level bins. At the end of the measurement period, often one hour (3600 data samples), the number of times each level occurred is counted and the number is summed from the highest level to the lowest level. The highest level is obviously exceeded 0% of the time and the lowest level is exceeded 100% of the time. The rest of the levels result in percentages between the two limits and are denoted  $L_x$  where x is the percentile. If Y is 15 minutes in one hour, then the  $L_{25}$  value is calculated and compared with the ordinance provision.

**This feature of a meter is useful only if ordinance provisions contain percentage time limits.**

## E.8 Meter Level Range (Noise Floor)

The range of levels that the meter is capable of measuring is important. Those designed for the workplace can measure levels up to 140 dB (typically called *noise dosimeters*). These are not needed for noise ordinance enforcement. High quality meters can measure below 20 dB, but they are more expensive. When the actual levels drop below the lower limit of the meter, the meter reads the internal noise (noise floor) as a sound level. Most noise ordinances have 45 dB(A) as the lowest maximum limit; this means that the meter should be able to measure sound 10 dB lower; the noise floor should be near 35 dB. Many low cost meters have a noise floor of about 40 dB, which can be useful if the lowest limit level is 50 dB(A). The upper limit of most meters used in environmental measurements is adequate to measure the sound of loud band music.

**Meters with a noise floor of 35 dB, or less, are recommended.**

## E.9 Maximum/Minimum Levels ( $L_{\max}/L_{\min}$ )

Some meters have the capability to store readings over a period of time and then report the maximum and minimum of those readings. For a noise ordinance provision that sets an absolute maximum level at any time, the maximum capability is a distinct advantage.

**Meters with a maximum reading capability are recommended as a useful, but only as an option.**

## E.10 Data Storage, Recovery, and Export

An important and useful feature is to provide evidence of readings by storing them. An additional advantage is being able to recover the stored data; exporting the data to a central computer. The more complex meters store many types of data and are able to upload them.

**Data display, storage, recovery, and export in the meter are recommended if citations are likely to be fought by potential offenders.**

## E.11 Calibrators

Sound meter response will change with time. In adversarial situations, the first question asked will be “Was the meter calibrated before and after use?” A quality calibrator is required. Most calibrators use one frequency to set the correct level, either 250 Hz or 1000 Hz. Since noise enforcement will use weighting filters, the recommended frequency is 1000 Hz where the filters have no influence. Some calibrators allow calibration at two levels, either 94 dB or 114 dB. Since environmental levels are almost always below 94 dB, that level is recommended. Some manufacturers assign classes to their calibrators based on precision.

**Class 2 calibrators are *strongly* recommended. The calibrator supplied by the same manufacturer as the meter and microphone is recommended. Multi-frequency calibrators are not necessary. Calibrators should be re-certified about once a year.**

## **E.12 Earphones**

Most meters have an AC output. Listening to the sound being measured is a quick way to evaluate the significance of ambient or wind interference.

**Earphones are recommended.**

## **E.13 iPhones and iPads**

Technology has been miniaturized to the point that small cell phones can have a high quality sound measurement capability. Currently, a cell phone can be a real time analyzer, or an overall level meter that displays graphs. The data can be stored and exported to remote sites. It requires a plug-in microphone and a calibrator. Since the device is a phone, the device can act as a normal telephone as well and with the possible capability of wireless data transfer. No information on the abilities or quality of such devices is presently available so no recommendation is given.

## **E.14 Manufacturers of Sound Level Meters**

There are many manufacturers of high quality meters, both national and international. They can easily be found on the internet. Choose those that supply calibrators with certificates and are willing to certify that the meter meets at least Type 2 requirements.

# Appendix F

## Representative Penalties for Noise Violations

### F.1 States

#### Delaware

Stationary source violation: \$25 to \$500 per day  
Willful stationary source violation: \$500 to \$3000 per day.  
Motor vehicle violation: \$25 to \$1000

#### Hawaii

Motor vehicle violations: \$25 to \$2500 per day.  
Other violations: less than \$10,000 per day.

#### Louisiana

Motor vehicle sound system violation: Not less than \$500

#### Maine

Motorboat operating violation: \$100 to \$500  
Motorboat muffler violation: up to \$100  
All-terrain vehicle violation: \$100 to \$500  
Sound system violation: 1<sup>st</sup> \$50, 2<sup>nd</sup> \$100, 3<sup>rd</sup> \$150

#### Maryland

Public place or convenience violation: 60 days or less than \$500, or both

#### Massachusetts

Tire squeal/drag racing violation: 2.5 years or less or less than \$1000

#### Missouri

Motorboat violation: 1<sup>st</sup> \$100 2<sup>nd</sup> \$200 3<sup>rd</sup> \$300

#### New Hampshire

Motorcycle violation: \$100 to \$300

#### New Jersey

Motor vehicle violation \$25 to \$1000  
Noise Control act violation: up to \$3000 per day

#### Rhode Island

Sound system violation: 1<sup>st</sup> \$100 2<sup>nd</sup> \$200 3<sup>rd</sup> \$300

#### South Carolina

Motorboat violation: 1<sup>st</sup> \$50 to \$200 2<sup>nd</sup> \$100 to \$200 3<sup>rd</sup> \$200 to \$500

#### Virginia

Most violations: 1<sup>st</sup> up to \$250 subsequent up to \$500

#### Washington

Dynamic brake violation: 1<sup>st</sup> \$250 2<sup>nd</sup> \$500 subsequent \$750  
Department noise rule violation: \$100

## F.2 Cities

Albany, NY

Ordinance violations: up to \$250, 15 days, or both

Albuquerque, NM

Ordinance violation: 1<sup>st</sup> \$100 2<sup>nd</sup> \$250 3<sup>rd</sup> \$500 (per day)

Anchorage, AK

Vehicle sound system violation: 1<sup>st</sup> \$100 2<sup>nd</sup> \$300 3<sup>rd</sup> \$1000

Burlington, VT

Noisy parties violation: 1<sup>st</sup> \$300 plus up to 15 hours “restorative justice”

2<sup>nd</sup> \$400 plus up to 18 hours “restorative justice”

3<sup>rd</sup> \$500

Note: applies to each resident

Other violations: 1<sup>st</sup> \$200 2<sup>nd</sup> \$300 3<sup>rd</sup> \$500

Colorado Springs, CO

Sound amplification system violation: 1<sup>st</sup> \$75 to \$500 2<sup>nd</sup> \$150 to \$500 3<sup>rd</sup> \$300 to \$500

Fairbanks, AK

Sound amplification system violation: 1<sup>st</sup> \$50 2<sup>nd</sup> \$300 3<sup>rd</sup> \$1000

Hartford, CT

Ordinance violation: up to \$90 or 25 days

Louisville, KY

Ordinance violation: 1<sup>st</sup> \$100 to \$250 2<sup>nd</sup> \$250 to \$500 3<sup>rd</sup> \$500 to \$1000

Mobile, AL

Music violation: \$150 , community service, imprisonment

Morgantown, WV

Ordinance violation: up to \$500

New York City, NY

The ordinance contains an extensive list of penalties in Table V of the code.

Phoenix, AZ

Barking dog civil violation: \$150 to \$2,500

Barking dog criminal violation: \$150 and up